MAY 1975

rsc

RAILWAY SYSTEM CONTROLS

Covering All Signaling, Communications and Data Processing

Northern C&S meeting: New solutions for long-term problems

Cracked-wheel detector "could save millions"

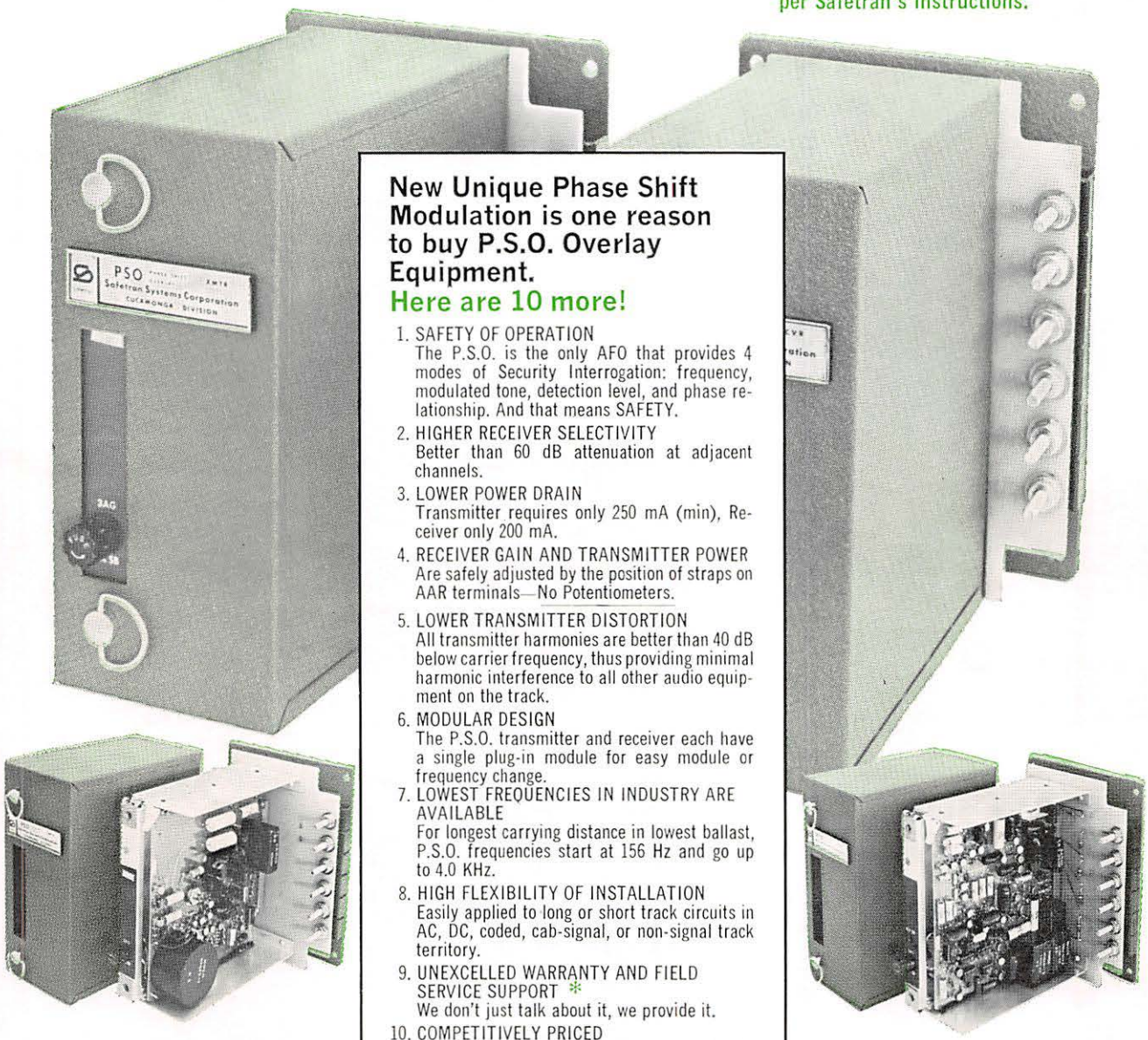
Problems and techniques in the use of audio frequency track circuits

CF77 G SS
R R TAYLOR
27W 174 BAUER RD
NAPERVILLE ILL 60540

When Safetran says P.S.O. has maximum immunity and reliability— we mean maximum.

NEW PHASE SHIFT OVERLAY EQUIPMENT

*P.S.O. IS WARRANTED AGAINST ANY FAILURE (DURING NORMAL USE) OR DAMAGE DUE TO LIGHTNING FOR A PERIOD OF ONE YEAR FROM DATE OF SHIPMENT, when installed and operated per Safetran's instructions.



New Unique Phase Shift Modulation is one reason to buy P.S.O. Overlay Equipment.

Here are 10 more!

1. SAFETY OF OPERATION
   The P.S.O. is the only AFO that provides 4 modes of Security Interrogation: frequency, modulated tone, detection level, and phase relationship. And that means SAFETY.
2. HIGHER RECEIVER SELECTIVITY
   Better than 60 dB attenuation at adjacent channels.
3. LOWER POWER DRAIN
   Transmitter requires only 250 mA (min), Receiver only 200 mA.
4. RECEIVER GAIN AND TRANSMITTER POWER
   Are safely adjusted by the position of straps on AAR terminals—No Potentiometers.
5. LOWER TRANSMITTER DISTORTION
   All transmitter harmonies are better than 40 dB below carrier frequency, thus providing minimal harmonic interference to all other audio equipment on the track.
6. MODULAR DESIGN
   The P.S.O. transmitter and receiver each have a single plug-in module for easy module or frequency change.
7. LOWEST FREQUENCIES IN INDUSTRY ARE AVAILABLE
   For longest carrying distance in lowest ballast, P.S.O. frequencies start at 156 Hz and go up to 4.0 KHz.
8. HIGH FLEXIBILITY OF INSTALLATION
   Easily applied to long or short track circuits in AC, DC, coded, cab-signal, or non-signal track territory.
9. UNEXCELLED WARRANTY AND FIELD SERVICE SUPPORT *
   We don't just talk about it, we provide it.
10. COMPETITIVELY PRICED
    When you check feature for feature, and price for price, you'll like ours.

Safetran Systems Corporation

7721 National Turnpike • Louisville, KY 40214 • (502) 361-1691

Circle 1 on Reader Service Card.

BE INFORMED
KEEP INFORMED

Subscribe to **RAILWAY SYSTEM CONTROLS**

for the technical aspects of communications, data processing and signaling activities in the railway industry.

Subscribe to **RAILWAY AGE**

for all the news about what's going on in the railway industry.

May 1975

RAILWAY SYSTEM CONTROLS

SUBSCRIPTION ORDER CARD

☐ 2 Years—$6 ☐ Payment encl. ☐ Bill my company
☐ 1 Year—$4 ☐ Bill me

☐ Enter ☐ Renew subscription for term checked above.

(Please print)

NAME_____

☐ BUSINESS
☐ HOME ADD. _____

CITY & STATE_____

ZIP CODE_____

RAILROAD_____

DEPT. _____

TITLE_____

For the **BIG RAILROAD PICTURE**
You also need **RAILWAY AGE**
☐ 2 Years—$12 ☐ 1 Year—$8

Above rates apply only to railroad men in U.S. and possessions, Canada and Mexico. Foreign and non-industry rates furnished on request.

BE INFORMED
KEEP INFORMED

Subscribe to **RAILWAY SYSTEM CONTROLS**

for the technical aspects of communications, data processing and signaling activities in the railway industry.

Subscribe to **RAILWAY AGE**

for all the news about what's going on in the railway industry.

First Class
Permit No. 153
New York, N.Y.

BUSINESS REPLY MAIL
No Postage Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

Circulation Department
RAILWAY SYSTEM CONTROLS
P.O. Box 530
Bristol, Ct. 06010

MAY 1975 Vol. 6 No. 5

RAILWAY SYSTEM CONTROLS

(Formerly Railway Signaling & Communications)

FEATURED THIS MONTH:

Northern C&S meeting: New solutions for long-term problems 8

Cracked-wheel detector "could save millions" 12

Training aid is suggested for mechanical locking 15

AAR Signal Training Bulletin C-13 18

Problems and techniques in the use of audio frequency track circuits 22

DEPARTMENTS:

Industry News 5

RSC News 6

People 20

Publications 25

Product News 26

50 Years Ago in Railway Signaling 27

Published monthly by Simmons-Boardman Publishing Corporation, 508 Birch St., Bristol, Conn. 06010, with executive office at 350 Broadway, New York, N.Y. 10013. Second class postage paid at Bristol, Conn. 06010 and at additional mailing offices.

Member of the Audit Bureau of Circulations (A.B.C.) Name registered in U.S. Patent Office. Printed in U.S.A. by the Johnson Press, Inc., 800 North Court St., Pontiac, Ill. 61764.

Copyright © 1975 Simmons-Boardman Publishing Corporation

Member of

RPI RAILWAY PROGRESS INSTITUTE · ABC AUDITED PAID CIRCULATION · The Railway Age Group

Subscriptions: Address all subscriptions and correspondence concerning them to: Circulation Department, Railway System Controls, P.O. Box 530, Bristol, Conn. 06010. Change of address should reach us three weeks in advance of the next issue date. Send old address with the new, enclosing if possible your address label. The Post Office will not forward copies unless you provide extra postage. Duplicate copies cannot be sent.

Subscription price to railroad employees only in U.S., Possessions, Canada and Mexico, $4.00 one year, $6.00 two years. All others $7.00 one year, $10.00 two years. Payable in advance and postage free. All other countries: $10.00 one year, $20.00 two years. Single copies 90¢.

POSTMASTER SEND FORM 3579 TO P.O. BOX 530, BRISTOL, CONN. 06010.

Editorial and Executive Offices
350 Broadway, New York, N.Y. 10013

Robert G. Lewis, Publisher

Al Klinger, Editor

June Meyer, Assistant Editor

Peter I. Pallans, Production Manager

Maurice H. Mates, Art Director

Cathy Whittaker
Manager of Contracts

John S. Rogers, Director of Circulation
P.O. Box 530, Bristol, Conn. 06010

ADVERTISING SALES:

New York, N.Y. 10013, 350 Broadway, Phone: 212-966-7700. W. Arthur Cubbage, Regional Sales Manager.

Chicago, Ill. 60602, 29 E. Madison St., Phone: 312-641-5815. Reid Kenedy, Vice President-Sales; John M. Brennan, Regional Sales Manager.

Pittsburgh, Pa. 15237, 1514 Northway Mall, Phone: 412-366-0100. Ronald M. Giallonardo, Regional Sales Manager.

Ormond Beach, Fl. 32070, 750 Lindenwood Circle, East, Phone: 904-672-6031. C. James Fisher.

Dallas, Tex. 75206, Noel Page Building, 6400 North Central Expressway, Phone: 214-361-6972. Joe Sanders, Joe Sanders & Associates.

Los Angeles, Cal. 90025, 11704 Wilshire Blvd., Phone: 213-477-4004. Fred Klaner, Jr.; Philip O. Bowers, The Klaner Co.

Sausalito, Cal. 94965, 3030 Bridgeway Bldg., Phone: 415-332-1481/2. Lewis A. Vogler, Lewis A. Vogler & Co.

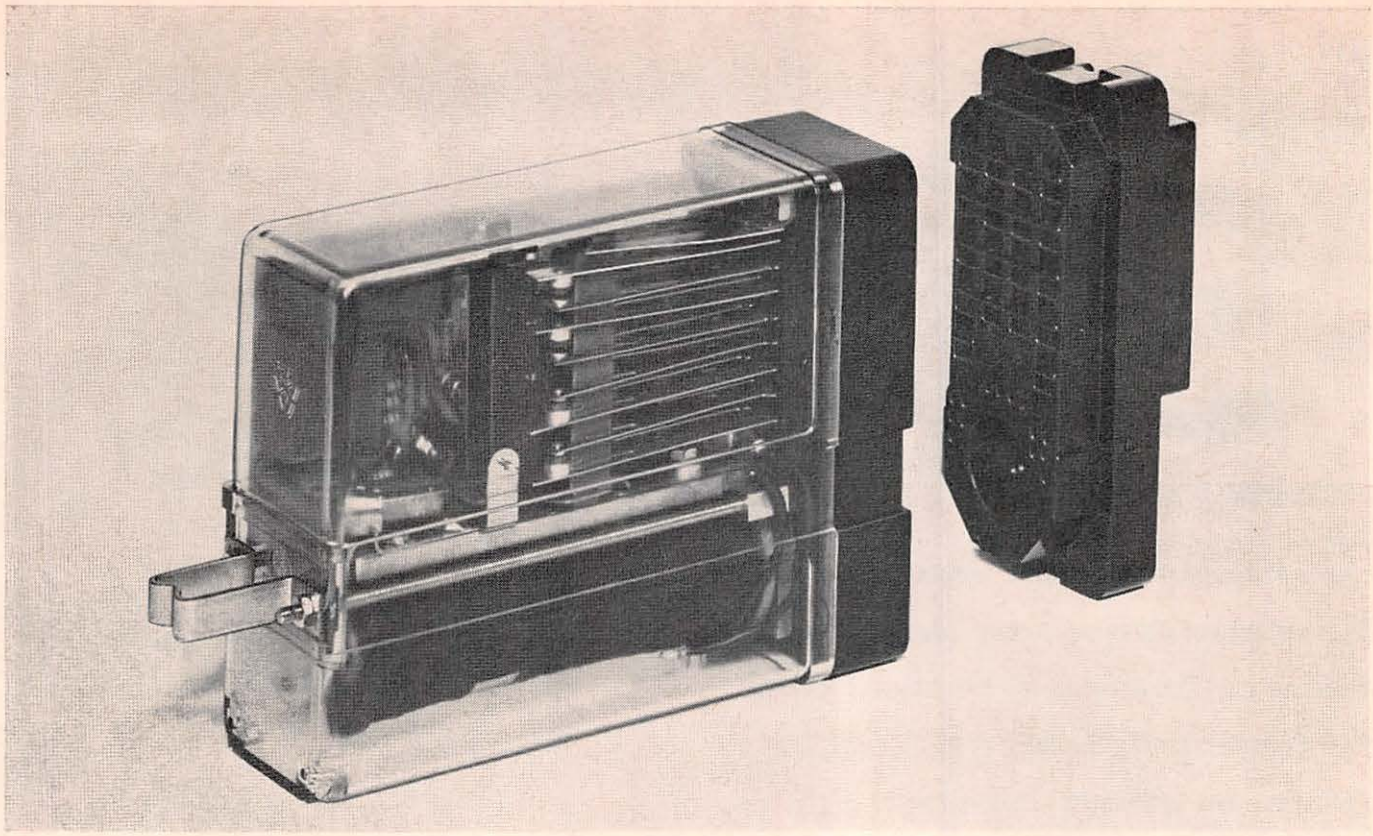
London, S.W.1, England, 67/68 Jermyn St., St. James's, Phone: 01-839-6318. Kenneth J. Hendry

Manchester 22, England, Haletop, Wythenshawe Civic Center, Phone: 061-437-3293. Ian Goulden.

Paris 8e, France, 70 Due de Ponthieu, Phone: 359-65-77. Stephen Brown-Joussard; Jean-Claude Lamoine.

4 Dusseldorf-Nord, Eitelstrasse 32, 652031; Erich Hillerbrand; Ronald Fischer.

Tokyo, Japan, Sun Gain Shia, Ltd., Shiba Nikkatsu Bldg., 13, Shiba Park, Minato-Ku. C. H. Yiu, Managing Director.



THE WORLD'S FIRST FAIL-SAFE SOLID-STATE TIMER THAT DOESN'T LOSE TRACK OF ITS RESPONSIBILITIES... EVER!

We have put a whole lot of new 'tricks' into a little box that will remove all the existing headaches and defects that conventional electro-mechanical timing mechanisms present.

Such problems as poor reliability, poor repeatability, low accuracy, limited temperature ranges etc., are overcome with our new solid-state, absolutely fail-safe timer module – the ST16.

* **A true fail-safe design philosophy.**
* **A completely solid-state timing circuit.**
* **Self-contained repeating relay BRB930 style with 8 output contacts.**
* **External programming of timing value in many increments.**
* **Operation from standard signalling supplies.**
* **High reliability and repeatability.**
* **High accuracy of timing over very wide temperature range.**
* **Economy in associated relay circuits.**
* **Housed in single width BRB930 style plug-in unit.**

The timer module is mounted within a single-width BRB930 series plug-in relay case (illustration shows a unit manufactured by Zone Controls Ltd.,) which also contains a standard signalling 8-contact relay. This combination permits simplification and allows considerable savings in associated relay circuits for many applications.

It is a solid-state completely fail-safe unit with an in-built technological integrity.

Typical Unit Specification:-
Slow operate externally programmable in the range 0-127 secs. 50 volt D.C. operation smooth or full wave rectified. (Other voltages and contact arrangements are available). 6F2B silver/carbon contacts.

Full details from:-

ML

M.L. Engineering (Plymouth) Limited.
Electrical Division.
Burrington Way,
Plymouth,
Devon
England.
Telephone: Plymouth 702541
Telex: 45383
Cables: EMEL Plymouth.

Patents Pending

Circle 4 on Reader Service Card.

Industry news

. . . a quick look at current events throughout the railroad industry

The nation's railroad industry suffered its first quarterly deficit in net operating income in its long history during the first quarter of this year. According to the Association of American Railroads, the industry's net railway operating income plummeted to a deficit of $93.5 million, compared with a profit of $146.4 million a year earlier. At the same time, with 80% of the reporting railroads showing declines in ordinary income, an overall deficit of nearly $151 million in ordinary income, the largest since 1938, was reported. In the first quarter of last year, ordinary income was $105 million on the plus side. But on a positive note, Stephen Ailes, AAR president, emphasized that the railroad industry "may well be on its way back to a healthier climate," due to the fact that the nationwide recession "appears to be bottoming out" and because of freight rate increases that the industry was allowed to put into effect early in the second quarter.

Freight traffic on U.S. railroads during the week ended May 3 totaled an estimated 15.2 billion ton-miles, 13.1% below the corresponding week a year ago, according to the Association of American Railroads. Cumulative volume for the first 18 weeks of 1975 was an estimated 263 billion ton-miles, 12.5% below the comparable period last year.

A 7% freight-rate increase (minus holddowns) became effective April 12. In agreeing to this increase March 25, the ICC reversed an earlier ruling. "Exceptions" to the increase include import-export traffic (except coal), piggyback and container movements, motor vehicles and equipment, lumber and lumber products, and recyclable goods (except iron and steel scrap).

The Federal Railroad Administration is launching a four-part program to change the apparent lack of improvement in train-accident statistics. Acting Administrator Asaph H. Hall says action will include (1) a minimum inspection and surveillance effort to make sure all roads are reporting accidents properly and are complying with Federal safety regulations; (2) a major enforcement effort directed at 10 roads which had a 1974 accident rate exceeding 25 accidents per million train-miles; (3) investigation by field personnel of operating conditions and procedures of selected roads with low accident rates in order to be able to compare low- and high-rate carriers in terms of train operations and condition of track and equipment; and (4) use of more-sophisticated inspection equipment, which is expected to be available later in 1975.

Amtrak has ordered 30 new high-speed, lightweight diesel locomotives at a total cost of $16.3 million. The locomotives, to be built by the Electro-Motive Division of General Motors, are to be delivered in the first half of next year. They will be capable of traveling up to 125 miles per hour and will be used to haul Amtrak's new fleet of Metroliner cars, now under construction. Amtrak previously had 201 locomotives on order.

RSC News

Three sectional meetings are held by C&S Section

The Communication and Signal Section of the Association of American Railroads, held this year's first Sectional Meeting at the Hotel Fort Garry in Winnipeg, Man. on April 1. Chairman for the Northern meeting was V. A. McGregor, regional engineer signals, Canadian National. Committee of Direction Sponsor was T. E. Munford, manager of communications, CP Rail.

This year's Western meeting was held at the Plaza Hotel in Kansas City, Mo. on April 24. Chairman for this meeting was R. H. Brenneman, director communications, Union Pacific. Committee of Direction Sponsor was T. M. Evans, director of communications, Chicago & North Western.

The Eastern meeting is being held at the Pittsburgh Marriott Inn in Pittsburgh, Pa. on May 29. The program will include a keynote address by H. G. Allyn, president, Pittsburgh & Lake Erie, and technical papers by representatives of railroads and their suppliers on a variety of subjects relating to railroad communications and signals. Chairman of the meeting is John D. Rock, superintendent communications and signals, P&LE and the Program Chairman is William H. Martin, superintendent signals and telephone, Union Railroad. Committee of Direction Sponsor is F. F. Fotta, chief engineer, communications & signals, Boston & Maine.

D&RGW reports change for annual signal survey

The Denver & Rio Grande Western has reported that figures submitted for the number of highway grade crossing protection units installed on the D&RGW during 1974 (RSC, January 1975, p. 12), were incorrect. The correct figures follow: two highway grade crossings protected by flashing-light signals; one highway grade crossing protected by flashing-light signals and gates. The corrected figures give a new total of 782 flashing-light signals and 422 flashing-light signals and gates being installed by the reporting U.S. and Canadian roads during 1974.

Chessie orders equipment for CTC

The Chessie System recently placed an order with Harmon Electronics, Grain Valley, Mo., to supply equipment and engineering for a new centralized traffic control dispatching center on the Chesapeake & Ohio at Richmond, Va.

The new dispatching center will control the entire Virginia Division main line from Hinton, W. Va., to Newport News, a total of about 600 miles. Equipment to be furnished consists of control consoles, a 40-ft-long display board, and control equipment based on Harmon's NOVILOG system which will interface the dispatcher's equipment to the various existing code systems.

A train control processor will also be furnished which assists the dispatchers in executing controls over the switches and signals in their territory. Harmon Electronics is also providing engineering work on field signal circuits involving the removal of a number of controlled sidings and electric locks and other track and signal changes in connection with the same project.

WABCO to distribute WALPAR equipment

The Union Switch & Signal Division of WABCO has been named by WALPAR, Inc. of Birmingham, Ala., as distributor of cantilever structures for the support of grade crossing warning lights and signs to the railroad industry. WABCO will also distribute WALPAR-manufactured signal bridges designed for the support of railroad signals.

Servo nominated as "Subcontractor of the Year"

In a national program sponsored by the U.S. Small Business Administration, Servo Corp. of America was nominated as "1974 Small Subcontractor of the Year". In a recent ceremony at the company's Hicksville, N.Y., headquarters, a certificate was presented to Servo President Henry Blackstone by L. N. Koivula of the S.B.A. The certificate's citation reads: "The United States of America Small Business Administration presents this Certificate to Servo Corporation of America in recognition for being nominated as National Small Subcontractor of the Year and for outstanding contribution and service to the nation's needs."

Semaphores are disappearing on the Milwaukee Road

The last alternating-current semaphore signals on the Milwaukee Road's main line between Chicago and Hastings, Minn., have been replaced with direct-current color light signals.

The semaphores are being replaced with color light signals as part of an on-going program to modernize automatic block signals on the road. In addition, about 50 signals between Davis Junction and Savanna, Ill., are scheduled to undergo this conversion during this year and next. Completion of this work in 1976 will mark the end of the use of semaphore signals on the Milwaukee Road.

These projects involve removal of the old signal head with its semaphore arm and lamp unit. New color light units are supported on existing signal poles and the related control equipment and batteries are housed in existing cases.

The alternating-current semaphores are being replaced now because of problems with securing replacement parts. The alternating-current semaphores tend to wear faster than direct-current semaphores. Direct-current semaphores, at least for the immediate future, will be kept in operation.

LMCC elects new president

William M. Lee, radio engineer for the Virginia State Police, is the new president of the Land Mobile Communications Council. Lee succeeds E. W. Downer, senior communications engineer of the Cleveland Electric Illuminating Co. of Cleveland, Ohio.

LMCC is comprised of the leading radio communications associations in the United States plus other organizations which include the Association of American Railroads. Twenty-four associations representing virtually every phase of the American economy support the LMCC's work in seeking a solution to frequency congestion in the Land Mobile Radio Services.

Other officers elected at LMCC's recent annual meeting in Washington, D.C., were Robert S. Black of Exxon Co., Houston, Tex., vice-president; Lawrence J. Lewis of Jersey City, N.J., manager of the Port of New York Authority, secretary; William Elder of the American Trucking Association, Washington, D.C., treasurer, and Downer, executive committee member at large.

The AAR is represented in the LMCC by Hugh M. Robertson of the AAR's Washington office and L. R. Thomas of Chicago. Thomas is general superintendent of communications and signals, Santa Fe.

Don't stop traffic to measure frequency

Using an EIP microwave counter, you can easily test high-density communications links without removing them from service. Here's why.

Many communication applications require measurement of the carrier of a frequency modulated (FM) signal. A counter's ability to measure such a signal is determined by its FM tolerance, the maximum deviation it can tolerate at a given modulation rate.

EIP microwave counters use Autohet™ technology to completely eliminate such a problem. They will measure the center or carrier frequency in the presence of 40-MHz peak-to-peak modulation, worst case. In the best case, an EIP counter can measure with as much as 200-MHz peak-to-peak deviation, an obvious advantage to any communication system manufacturer or end user.

And if you have an electronic warfare application, an EIP microwave counter lets you test vital EW/ECM circuits in-service, too.

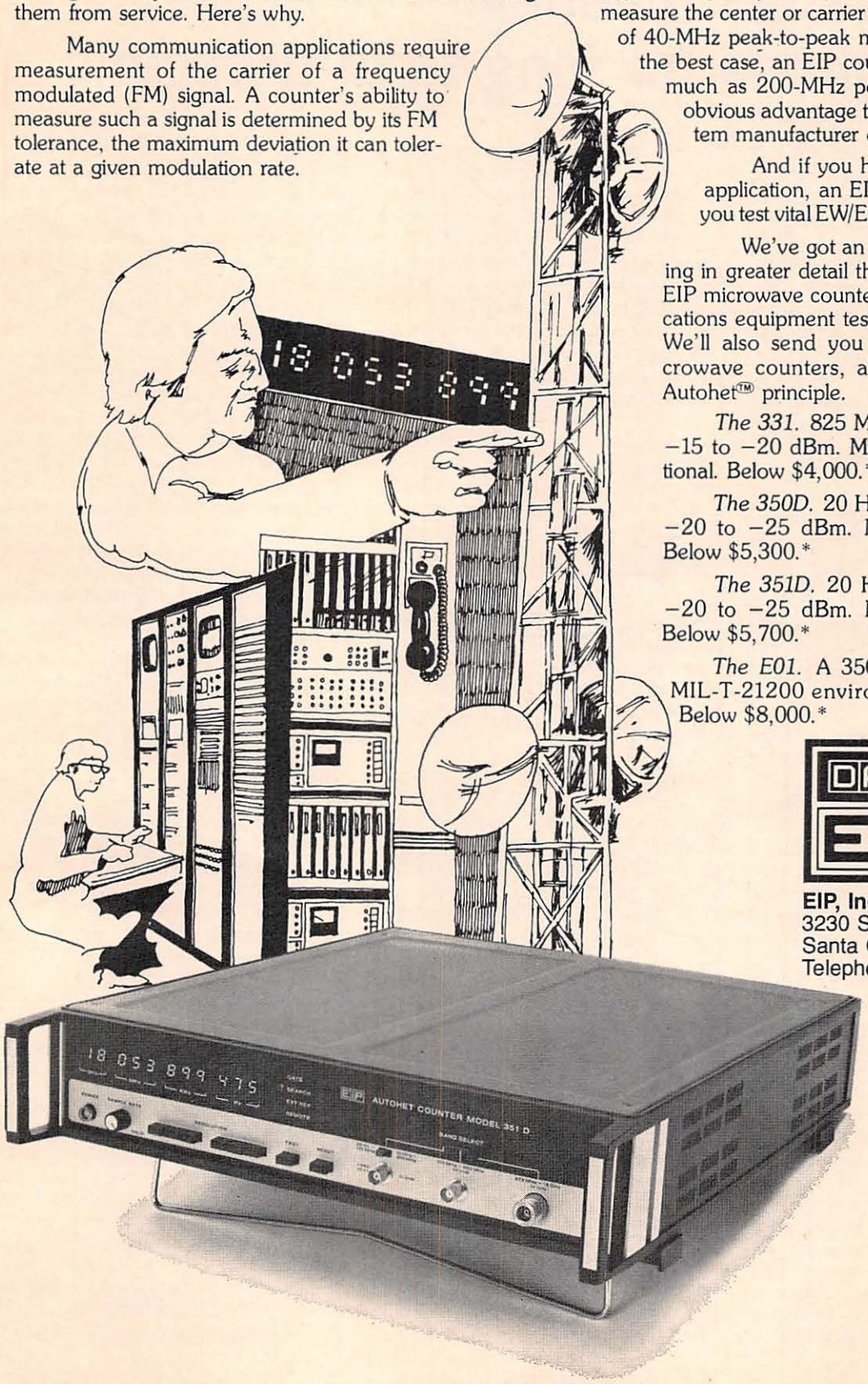
We've got an applications note explaining in greater detail the advantages of using an EIP microwave counter for in-service communications equipment testing. Write for your copy. We'll also send you information on our microwave counters, all constructed using the Autohet™ principle.

The 331. 825 MHz to 18 GHz. Sensitivity −15 to −20 dBm. Minus 20 to −25 dBm optional. Below $4,000.*

The 350D. 20 Hz to 12.4 GHz. Sensitivity −20 to −25 dBm. Minus 30 dBm optional. Below $5,300.*

The 351D. 20 Hz to 18 GHz. Sensitivity −20 to −25 dBm. Minus 30 dBm optional. Below $5,700.*

The E01. A 350D or 351D designed to MIL-T-21200 environmental specifications. Below $8,000.*



DANA EIP

EIP, Inc.
3230 Scott Boulevard
Santa Clara, CA 95051
Telephone (408) 244-7975

*U.S. price F.O.B. Santa Clara

Circle 11 on Reader Service Card.

RSC RAILWAY SYSTEM CONTROLS

Northern C&S meeting: New solutions for long-term problems

This year's Northern Sectional Meeting of the Association of American Railroads' Communication and Signal Section was held on April 1, at the Hotel Fort Garry in Winnipeg, Man., Can. According to V. A. McGregor, regional engineer signals, Canadian National, "This is the first time that a meeting of this nature has been held outside the confines of the United States and Eastern Canada." McGregor was this year's chairman of the Northern Sectional meeting. Present were 158 representatives of Canadian and U.S. railroads, the Brotherhood of Railroad Signalmen, and some 15 supply companies.

During his opening remarks, McGregor went on to say that "through the efforts of the organizing committees and considerable direction and help from many sources we have been able to put together what we hope is a well balanced program containing items of interest to all those in attendance . . ." And indeed it was a well balanced program. Topics of interest ranged from computer-based ctc, to coping with equipment problems caused by some of the severe weather conditions of the northern environment.

This year's guest speaker was R. J. Hansen, assistant vice-president, Canadian National. Hansen commented on some of the major developments for which CN can take credit. These developments have included an automatic journal oiler, an electronic weigh-in-motion scale, a train simulator designed for locomotive engineer training, a track recorder car and a train handling recorder. Hansen explained that CN's technical research center is staffed by experts in almost all scientific disciplines and that its activities are directed to solutions for practical problems which confront the CN organization.

Turning towards a long range project which is facing the Canadian roads, G. A. Robertson, signal training development officer, CN, discussed the details of a metric conversion program that the Canadian government and industry is undertaking. The first signs of this conversion were noticed on April 1, when local weather forecasts were giving temperatures in degrees centigrade. The target date for complete conversion is 1980. Although some changes are already being made, Robertson pointed out that implementation is officially scheduled to occur between 1977 and 1980. Many of the conversions at this point are merely "soft conversions." A soft conversion is when the old weight and measures are simply listed in metric units. For example, if a milk bottle producer were to stamp 1.4 liters on his old quart bottles, he would be making a soft conversion. Hard conversion, which is the ultimate goal, is when the size or capacity is changed to conform to standard metric units.

Robertson said that the conversion will be a costly one, but that the costs are well justified. For the Canadian railroads, it not only means a metric conversion, but also, according to Robertson, an extensive employee training program to orient everyone to the new system.

Technical papers

Shortly after the morning coffee break, H. C. Kendall, senior consultant, General Railway Signal Co., presented a paper titled "The Importance of a Prime Ground." Kendall's presentation started out by explaining that in spite of what is known about the nature of lightning, the protection of equipment from damage due to lightning surges is not an exact science. Kendall said, "For any degree of protection, there will always be a time when some surge results in damage." But he went on to say, "Nevertheless, a degree of protection can be achieved where these occurrences become so infrequent that they cease to be a major irritation."

To achieve a high degree of protection, Kendall emphasized the importance of getting all components of a circuit to rise in potential *together* during a surge. "This," he said, "is where the Prime Ground Terminal comes in. The prime ground terminal is a single terminal to which all components of a location must be connected. To this terminal should be connected the ground lead of the buried ground contact, the heavy conductors from the lightning arresters on the incoming wires, the chassis of the equipment in the housing, the housing itself and the arresters from the rails. The terminal serves as sort of an interchange point and, regardless of which component a surge arrives on, it can leave the location through the path of least resistance. If, for instance, the ground contact at a particular location is not good, the surge may use the rails as the means of reaching true ground. In any event the terminal assumes some elevated potential and, because of the interconnections, all of the apparatus assumes the same potential and no harm is done."

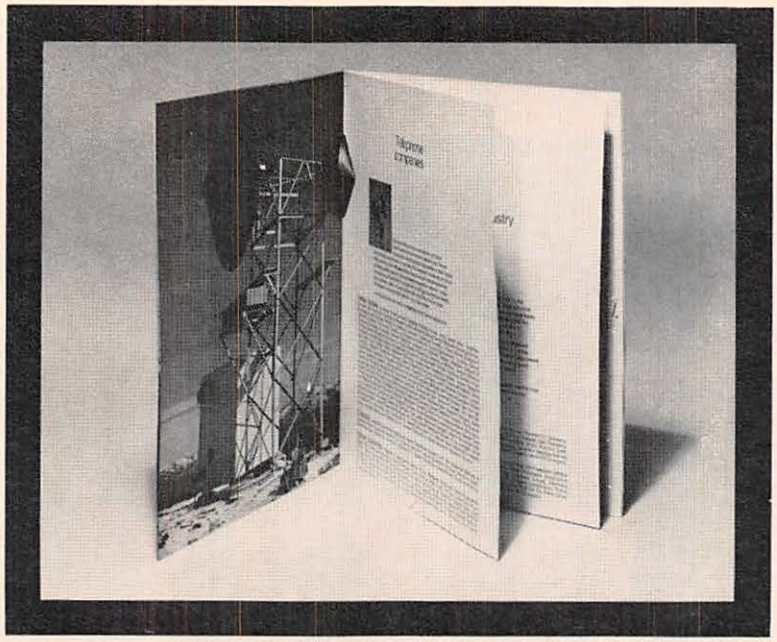
Kendall went on to explain some of the specifics of grounding techniques and some of the characteristics of various grounding schemes. He also emphasized the importance of properly locating apparatus within a bungalow.

TRC

Moving on to the third presentation of the morning, E. R. Leech, Communications Engineer, WABCO, discussed the system operating principles of WABCO's Total Radio Control (TRC), or otherwise described as a dispatcher-to-train radio communication system. Leech started by pointing out the need for a reliable voice communication and control system to operate the radio link between the dispatcher and train crews to complement ctc and high speed diesels. Although many railroads have previously extended their communications system to include dispatcher-to-train radio communications, Leech said that many of these systems have become outdated because they lack the speed and flexibility of operation required by today's busy railroad dispatchers.

After careful analysis of requirements, WABCO undertook extensive research and development work related to

Farinon Makes It Easy..



..to find the users of Farinon Microwave Systems in your industry

It's Easy First..Because There's A Lot Of Them..

in a variety of industries . . in every state in the U.S. . . in Canada . . and, in 73 other countries throughout the world from Angola . . to Zanzibar.

So, without too much fear of contradiction . . we can say "Someone you know communicates via Farinon." The current list includes:

- 109 telephone companies
- 42 public utilities
- 53 pipeline/petroleum companies
- 95 government agencies
- 24 other users from railroads to broadcasters

And, We've Put Them All In A Book..

with Farinon users listed by industry and location. And, it's yours for the asking from any of our offices listed below:

General Office:

- **San Carlos**
  CA, 94070 • 1691 Bayport Ave. . . (415) 593-8491

Sales Offices:

- **Atlanta**
  GA, 30341 • 5582 Peachtree Rd. . . (404) 451-1982
- **Houston**
  TX, 77024 • 710 N. Post Oak Rd. #222 . .
  (713) 688-5569
- **Somerville**
  NJ, 08876 • P.O. Box 148 . . (201) 526-2269

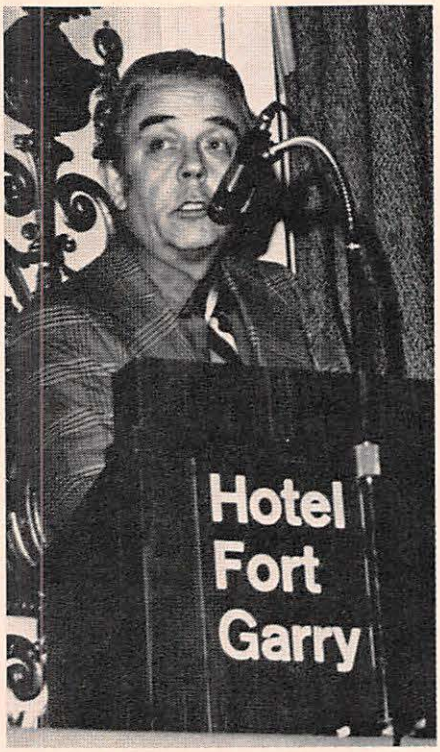
In Canada: **Farinon Electric of Canada, Ltd.**

- **General Offices at Dorval, P.Q.**
  657 Orly Ave., H9P 1G1 . . (514) 636-0974
- **Sales Office, Calgary, Alberta**
  6 Heritage Dr., S.E. #L-12, T2H 2B8 . . (403) 259-2429

Farinon MICROWAVE MULTIPLEX

Circle 5 on Reader Service Card.

"Your presence here today is a clear indication of your continued interest in and support of the activities of the section."



V. A. McGregor, (Chairman) regional engineer signals, CN.

"We should take stock of what railway research is being conducted and determine whether it is relevant to current needs."

R. J. Hansen, assistant vice-president, Prairie Region, CN.

"In spite of what is known, the protection of equipment from damage due to lightning surges is not an exact science . . ."

H. C. Kendall, senior consultant, technical marketing, GRS.

the design of a reliable, flexible, dispatcher-to-train communication system of minimum complexity and which would provide improved overall operations. A WABCO TRC system is not a firm circuit, but rather a configuration of a group of standard circuits, custom assembled and interwired to meet the individual operational requirements of a railroad customer for complete control of a radio system consisting of one or more office control points and several radio wayside station locations.

Computer-based CTC

"Computer-based centralized traffic control provides railroads with an operating tool to more effectively integrate the dispatch function. This capability may be attributed to the system's inherent capacity to rapidly gather data from multiple sources; to quickly analyze this data; and to make operating decisions based on predetermined transportation objectives." This was a brief description of TRW's computer-based ctc system presented by A. C. Tauch, marketing manager, railway systems, TRW Controls, in his presentation titled, "Computer-Based CTC and its Application for Computerized Train Dispatching."

Tauch went on to say, "Computer-based ctc incorporates the same functions provided by conventional control machines. There are the acquisition and display of field data, and the control of track side facilities.

"Permanent records are automatically typed to document all operating occurrences. Operating data in conjunction with information entered by the dispatcher provides the data base for numerous, edited, formatted reports. All system occurrences are tagged by name, location, year, month, day, hour, minute and second.

"Cathode Ray Tubes (CRT's) provide comprehensive track model displays. A dispatcher request provides an almost instantaneous display of various levels of track models and information.

"Through the console, the dispatcher may assign each train one of three priority levels. Based on these priorities, the system will automatically handle, in sequence, all track and siding alignments to complete all meets. The dispatcher may, however, override the system decision with a manually entered 'meet' command. As a result, a single 'meet' command will generate multiple controls in sequence to complete the dispatcher-selected meet."

Tauch also said that computerized train dispatching is more than a dispatching tool. He said, "It is a management tool which will optimize the dispatch function based on predetermined management and transportation objectives."

Local control

The Canadian Pacific's Schreiber Division passes through the rugged and remote terrain of Northern Ontario. With its extreme climatic conditions it continues to present many challenges related to the movement of trains and the need for minimizing delays. CP signal officers, having recognized certain problem areas, recommended a number of special features to be built into the ctc system for this territory.

In a presentation titled, "CTC with Signaled Siding—Automatic Clearing and Local control", G. C. Gunning, superintendent of signals, CP Rail, described some of the details of the ctc system on the Schreiber Division.

Gunning described the division as

"Metric conversion will require railroads to establish training programs to familiarize employees with the new system."

G. A. Robertson, signal training development officer, CN.

being subdivided into four subdivisions which total about 515 miles of single track. Many areas of the system are accessible only by rail. According to Gunning, "Since the transportation of signal maintainers is restricted mostly to track motor cars, involving delays in moving to any problem areas, it was felt that a scheme whereby trains can be kept moving by an alternate method of clearing signals would be desirable."

Depending on the traffic conditons, the control machine at Schreiber is operated by one or two dispatchers. The control link to the field consists of a mixture of coded carrier and dc code line. Other features of the system include: signalled sidings; automatic clearing of signals by the train; local control of switches and signals at siding ends; and clearance prevention.

Gunning explained that if the dispatcher were to lose control of a particular siding, due to an open code line, the train crew is able to use wayside or local controls for switching to enable a move to be made on signal indication. All sidings on the division are equipped with dual-controlled switch machines and signals. Assumming that no conflicting movement are present, all trains enter sidings on medium approach signal aspects at speeds up to 30 mph. The local controls are provided at the ends of each siding.

Work shop session

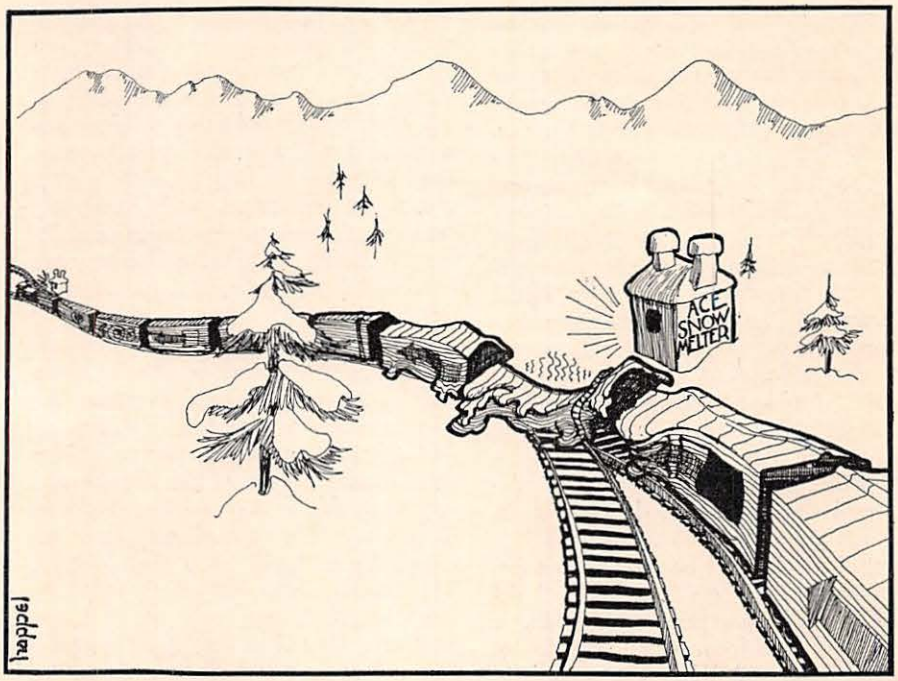
The last event on the program was a three-fold presentation about hot box detectors in a northern environment. The first talk was given by C. A. Gallagher, manager, new product lines, Servo Corp. Gallagher described some of the problems caused by ice, snow and moisture which are encountered at many of the hot box detector installations in some northern areas of the United States and Canada. These conditions can result in poor scanner readings. To minimize the effects of swirling snow in the scanner region, trains are often required to move slowly past scanners. Gallagher talked about various studies which have attempted to establish a system for directing an air stream over the scanner to form a clear path for the scanner. So far, Gallagher said, the designs have not been totally effective. To minimize the effects of the winter environment, Gallagher recommended the following measures: insure close regulation of the incoming power which supplies the detector equipment; all equipment enclosures, junction boxes and scanners should be sealed against water and snow; scanners should be maintained in their sun-reflective condition by cleaning and painting with high quality aluminum paint, followed with several coats of polyurethane.

The second talk was given by D. H. Archer, regional signal supervisor, CP Rail. Archer described three main problems related to weather conditions experienced on the CP. Snow entering the scanner shutter during train passage was found to obstruct the optical mirrors, which resulted in loss of infrared reception. CP has developed a forced air system to solve this problem. The air, activated by track circuits, is forced from a track side blower through a 1⅔-in. underground pipe to the scanner. This air, which flows through the scanner housing, prevents any snow from entering the shutter opening.

Another problem, described by Archer, occurs during heavy snowfall. This results in complete coverage of a scanner. Archer said that the only sure cure for this problem is to manually clear the snow during and immediately after the snow fall.

The third problem described by Archer concerned the attenuating effects of swirling snow being present between the scanner and its target during train passage. To offset this effect, CP re-calibrates the equipment to compensate for the effects of swirling snow during the winter months.

The last speaker of the work shop session was A. F. Broughton, supervisor, signal maintenance, CN. Broughton told of CN's activities in dealing with the problem of ice buildup on hot-box scanners. According to Broughton, CN has solved the problem by covering the scanner and surrounding area with a thermal blanket. The blanket, which is a nylon impregnated canvas, is tailor-made to fit snugly over the scanner.



No! This time I think you've got it turned up a little too high . . .

Cracked-wheel detector "could save millions"

"We have the invention of the century! We have a device that can find cracked wheels on a moving train." This was the feeling expressed by Gerald Cowan, co-inventor of the system known as WHeeLFAX, during the early development stages of the cracked-wheel detector. Some four years, and several patents later, Cowan still feels that the WHeeLFAX system could save railroads millions of dollars which will be lost due to accidents caused by broken wheels.

The WHeeLFAX system relies on the disruption of the return signal that occurs when a high-frequency sound wave transmitted through metal hits a tiny crack. The ultrasonic method is similar, in principle, to the well known rail testing technique where ultrasonic wheels test the rail. Although the principle may be the same, the actual system has evolved into something quite different. WHeeLFAX was developed by a threesome who have been working on the system since 1971: Gerald Cowan, an electronics engineer; his brother John Cowan, a mechanical engineer; and John's son, John G. Cowan. Their collective experience with railroads and in rail testing, totals over 30 years.

With the help of Cary Hohl, sales manager, WHeeLFAX is being marketed under the company name of Scanning Systems, Inc. of Danbury, Conn. In June 1973, Scanning Systems installed a WHeeLFAX system in the Santa Fe's Argentine (Kan.) yard. This installation, set up primarily as a test site, is only one-half of a normal system since it only inspects wheels on one side of a train. Since that time, two more systems have been ordered: one to be installed in Florida East Coast's Jacksonville yard; and one for CP Rail's St. Luc yard in Montreal. CP Rail's system will cost about $100,000. FEC's system will be somewhat more because of an option which will permit high-flange detection.

One problem, recognized during some of the first Santa Fe tests, was that the system may be too sensitive. The ultrasonic transducers, which form the heart of the rail-mounted search unit, are designed for producing a 400 KHz burst of mechanical energy. At this frequency, WHeeLFAX is capable of detecting cracks greater than .020-in. in depth. If the frequency were to go higher than 400 KHz, the sensitivity of WHeeLFAX would become greater. Conversely, if the frequency were less than 400 KHz, the sensitivity would become less. Why 400 KHz? Gerald Cowan says, "We felt that the device should be capable of finding a crack near its inception, before the crack has started to really progress. After all, you don't want to find out about a crack after the wheel has broken. You want to find it before the wheel has broken. However, at this time we don't have enough information, and neither do the railroads, to state the rate of crack propagation. In other words, does a crack have to be an eighth of an inch deep before it will cause failure, or does it have to be three eighths of an inch?"

Finding cracks of a certain depth isn't the only criterion used to consider a wheel dangerous. The location of a crack can mean the difference between scrapping, or just having the wheel machined below the defect. For example, rim face cracks originating from stamped numbers or car retarder score marks are not normally machined away. In any event, the WHeeLFAX system offers the promise of finding thermal and fatigue cracks in wheel treads, front rim edge, flanges and back rim faces on car wheels moving as fast as 30 mph in either direction. The system is now equipped to allow sensitivity adjustments to detect, or ignore, cracks of any specified size. Upon detection, defects are recorded on a trackside or remote ink pen recorder. In addition to the ink pen recorder, defects are signaled by a buzzer and a signal light which stays on until it is manually reset. Optionally, defective wheels can be marked with a pressure paint system. The unit can be tied in with an aci system or interfaced with computer equipment. Once the existence of a defect is known, its precise location can be checked with a hand test unit, also developed by Scanning Systems.

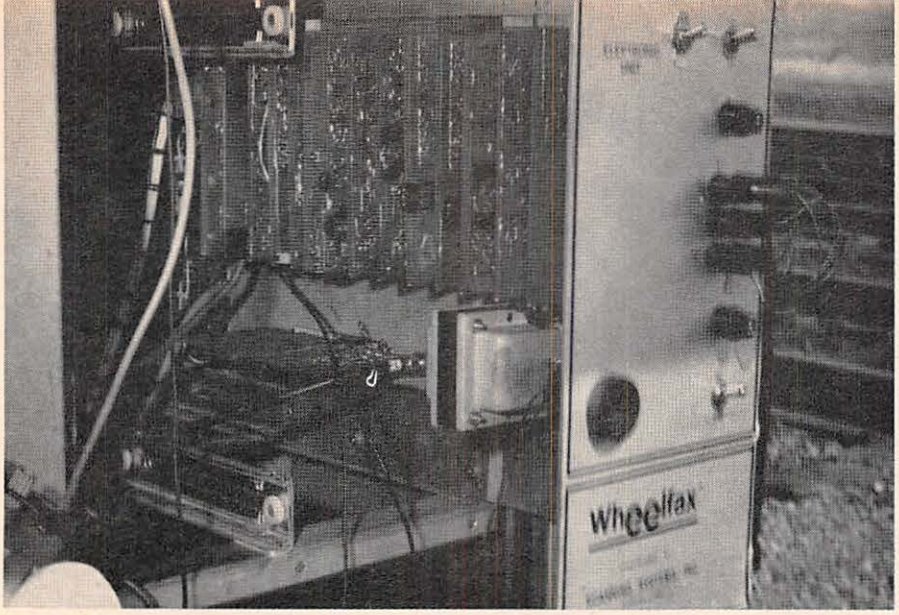
Major components in the system are located in track and track-side areas. The rail-mounted search unit houses two transducers aimed in opposite directions so that the ultrasonic energy goes around the rim of the wheel under test in clockwise and counter clockwise directions. The transducers are enclosed by a liquid filled flexible boot. The liquid, composed of ethylene glycol and water, not only offers freeze protection but also acts as a temperature compensating medium for coupling the ultrasonic sound waves to the flexible boot. The flexible boot, which extends one-half inch above the top of the rail, couples the energy to the passing wheel. As the wheel passes over the unit, it presses the surface of the boot downward so that it assumes the shape of the wheel tread surface for best possible testing conditions. Since ultrasonic sound will not pass through an air gap, a water spray, triggered by a sensor in the rail, sprays a mist on top of the boot and the approaching wheel to couple the boot to the wheel. As the wheel presses down on the flexible boot, a change in the pressure of the ethylene glycol mixture is detected by a sensor within the search unit assembly. This change is used to tell the track-side equipment that the wheel is in full contact with the search unit. To insure constant conditions over a wide range of temperatures, the search unit is also equipped with a 500 watt heater which maintains a constant temperature.

A complete WHeeLFAX installation consists of two search unit assemblies, each mounted in opposite rails to inspect wheels on both sides of a train. Each search unit, which measures 5½-in. wide by 8½-in. long, is mounted in a pocket provided in a special 39-ft. rail which was designed jointly with Abex. Wheels under test are guided against the gauge side of the rail and onto a special short rail section that carries the weight of the car on that portion of the tread adjacent to the flange. At the center of this rail, for a distance of about nine inches, the field side of the wheel tread hangs over the edge of the rail and makes contact with the flexible boot. The special 39-ft. rail assemblies are staggered in track about 100-ft. apart to prevent a tight gauge condition.

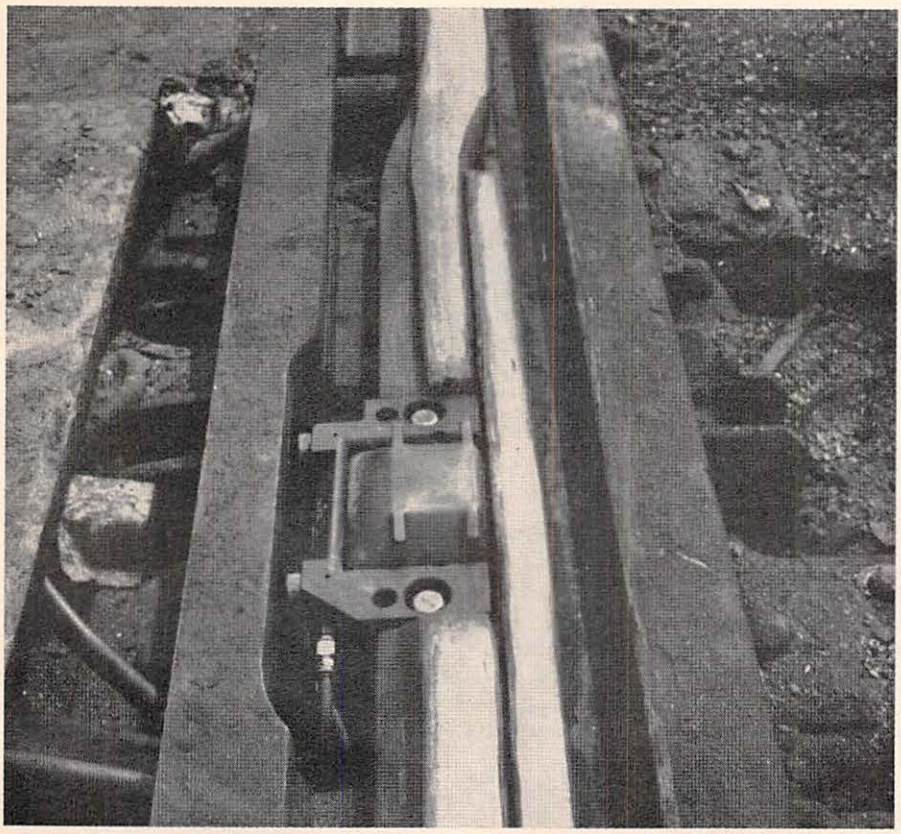
Also mounted in the 39-ft. rail assemblies are three sensor units for detecting the presence, passage and departure of a wheel. The sensors are coupled to trackside equipment to initiate the test sequence. The Santa Fe test site is equipped with only two sensor units but, due to certain requirements, it was decided that three will be needed for future installations.

Trackside equipment

The Cowans are recommending that trackside equipment be housed in a heated and/or air conditioned bungalow. The "central brain" of the trackside



Trackside equipment for the WHeeLFAX system will normally be housed in a heated and/or air conditioned bungalow. The above picture shows one of the solid-state data processing units which sends, receives, and interprets the signals associated with the rail-mounted search unit.



Each search unit assembly is mounted in a pocket provided in a special 39-ft. rail which was designed jointly with Abex.

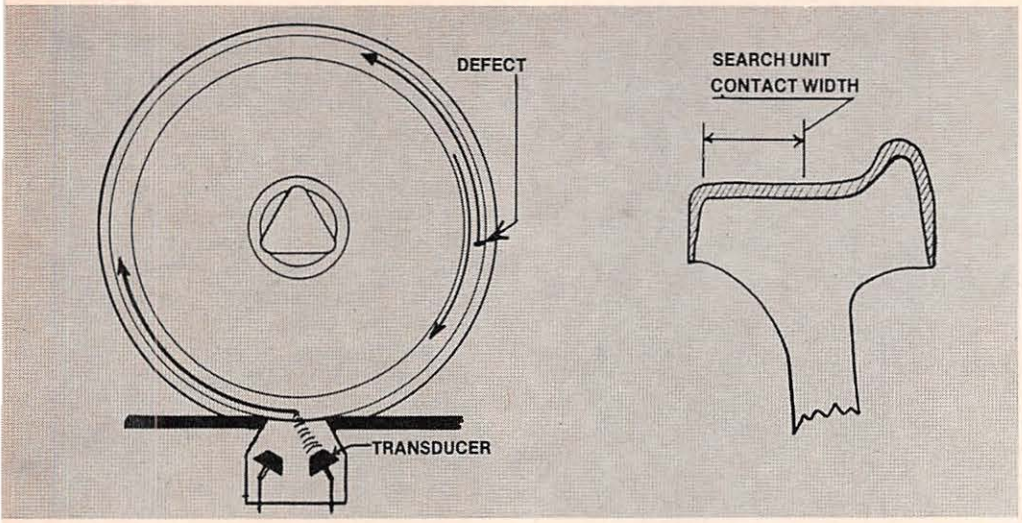
An approaching wheel is sprayed with a mist of water to effectively couple the wheel to the flexible boot of the search unit.

equipment consists of two data processing units (one for each search unit). The data processing units send, receive, and interpret the signals associated with the search units. Tied in with the data processing units is an ink pen recorder and all alarm outputs. The paint pump, paint reservoir, coupling liquid and an air compressor are also located in the trackside bungalow. Provision has been made to send monitor indications to a central location if the water, paint, air or power requirements are not maintained. As a final backup, the system will shut down if someone does not respond to the monitor indication. For example, if someone forgets to fill the paint reservoir after the low level has been indicated by the monitor, the paint pump will shut down, when the paint level has gone below a second level, so as to prevent damage to the related equipment. If the equipment does go to the final backup stage, it is indicated by a flashing monitor indication and all equipment is shut down.

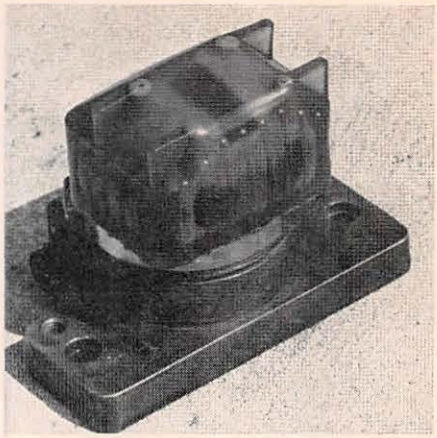
Mounted close to the data processing units is an oscilloscope. According to G. Cowan, the oscilloscope will be wired so that maintenance personnel will be able to monitor critical signals throughout the system.

Operation

As the wheel of an oncoming car triggers the first wheel sensor, all high-current equipment is shut off and the monitoring and recording equipment goes into a test condition. Any previously stored alarms are also cleared at this time. When the wheel triggers the second sensor unit, the water spray is turned on and the direction of the train is determined. This programs the system to properly test a wheel coming from that direction. As the wheel makes contact with the rubber boot of the search unit, a change in pressure within the boot triggers a sensor which enables the first pulse of sound energy to be introduced into the wheel tread by the first transducer. The transducers in the rail search unit point in opposite directions. The first pulse of energy will travel along the surface of the wheel in a clockwise direction, making several round trips. It takes about 1 millisecond for the signal to travel around a 32-in. wheel. Each time the signal travels around the wheel, a portion of the energy is received by the second transducer which is in the receive mode. The energy received by the second transducer verifies a through transmission has been achieved. The mechanical energy dies out after about five trips around the wheel. After the energy from the first pulse has dissipated, a second pulse is fired in a counterclock-



A defect in the wheel will reflect a portion of the ultrasonic signal back as an echo in the opposite direction from which it was sent by the transmitting transducer. Although energy enters the wheel tread in a beam about 1¾ in. wide, the signal fans out over the entire wheel tread, the front rim edge, flange and back rim face of the wheel.



The rail-mounted search unit houses two transducers aimed in opposite directions. The transducers are enclosed by a liquid filled flexible boot. Normally, a WHeeLFAX installation will include two complete search units to enable detection on both sides of a passing train.

wise direction around the wheel by the second transducer. Now the first transducer is in the receive mode and the same operation occurs as it did in the clockwise direction. At 30 mph, a wheel is in contact with the search unit boot for about 10 milliseconds, enough time to test a wheel at least once in both directions. At slower speeds, wheels are tested up to six, or more, times in each direction.

Assuming that a defect, such as a thermal crack, exists at some point in a wheel, a portion of the sound energy will be reflected back as an echo in the opposite direction of which it was fired. If this is the case, the sending transducer will receive the energy and the resulting signal will indicate that a crack exists. Since most of the energy from the initial pulse continues to travel around the wheel four or five more times, an echo will be reflected back to the transducer each time the pulse encounters the crack. At this time an alarm is generated by the data processing unit.

The number of echos received, and their amplitude will depend on the size of the crack, the attenuation of sound by the steel in the wheel, and the surface condition of the wheel. This wave form may be monitored on the oscilloscope.

After the initial pulse of sound energy travels about 20 inches around the wheel, it has fanned out over the entire wheel tread, the front rim edge, flange and back rim face of the wheel.

When the second transducer, aimed in the opposite direction, is activated after the sound in the initial drection has dissipated, defects that are better reflectors in one direction are also detected.

The water spray is shut off as soon as the first through transmission is detected. If for some reason the sound energy is not detected, a timing circuit will turn off the spray. As the wheel leaves the boot, and another pressure change is detected, the ultrasonic pulses stop transmitting.

As the wheel triggers the third wheel sensor, the data processing unit will cause the chart recorder to read out the information about the wheel. In the event of an alarm, the paint spray would also be triggered at this time.

Attenuation

The level of the electrical signal which drives the transducer, and the level of the electrical signal which is generated by a receiving transducer was found to differ by a tremendous amount. This was due to a number of factors. First, the efficiency of the transducer in converting electrical energy to mechanical energy causes a significant loss. Second, the means to couple the mechanical energy to the wheel offers a great deal of attenuation. This includes the liquid within the boot, the boot material, the water which couples the boot to the wheel and, of course, any dirt or grease which may be on the wheel or boot. These losses were no problem to compensate for since any signal can be amplified to a proper level. The problem was how to compensate for the varying degrees of attenuation offered by the wheel itself. During early tests on the Santa Fe, the Cowans found that the amount of attenuation offered by some wheels were found to be greater than other wheels by as much as 150 to 1. To compensate for this wide range of attenuation, the equipment was modified to compensate in a logarithmic fashion rather than linearly. In effect, the receiver portion of the data processing unit is compressing the incoming signals in much the same way an audio compressor works.

The Cowans are working on a number of options for the WHeeLFAX unit. One of the options, which will be included on the FEC's system, will enable the unit to check for high flanges. This is done by measuring the difference in time between the pulse traveling around the tread of the wheel and the flange of the wheel. But before the Cowans start development work on any of the other options, they want to get the FEC and CP rail systems installed and operating.

A hand test unit (WHeeLFAX JR) is used to determine the exact location and approximate size of wheel defects which have been detected by the track-mounted system.

Training aid is suggested for mechanical locking

By PAUL BRANNEN
Endwell, N.Y.

The advent of relay or circuit interlocking has reduced the amount of new interlocking installations employing mechanical locking to a probable minimum. There are still a large number of existing mechanical locking installations which must be maintained, inspected, repaired and sometimes changed. Hence, a knowledge of the basic elements of mechanical locking must be imparted to new signal department employees who will be responsible for these installations.

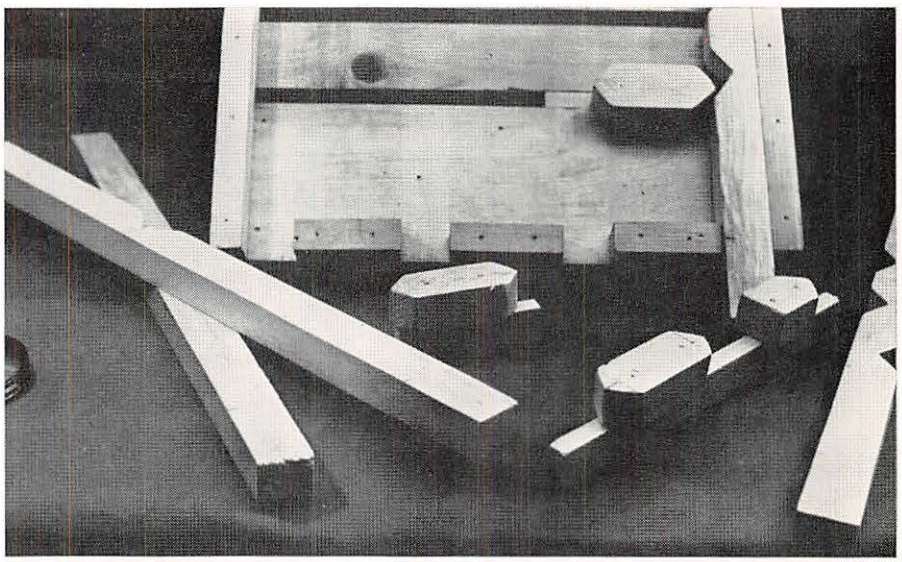
Study of theory on the subject—with books, locking tables and dogcharts, and the like—is necessary and worthwhile, but physical study of actual mechanical locking must also occur, to tie the theory to practice. Study of locking on a machine that is in service and working is better than nothing, but it has its obvious drawbacks of limited access to the instructor and student, complexity which can obscure the elementary aspects, and impossibility of changing locking to illustrate the effects of such changes.

Similarly, a small size locking bed using actual steel locking bars and dogs can be used for study, but the machining of the parts is expensive, and presumably only one such device would be made for a signal school because of cost. Also, the parts are relatively small, and hence not suited for classroom or lecture demonstrations to a group.

With these thoughts in mind, and faced with trying to explain the rudiments of mechanical interlocking without having any access to a mechanically locked machine, I decided to build a demonstration locking bed of wood, in a large enough size to make the parts clearly visible from a distance of ten feet or so, and readily changeable so that variations in the locking principles could be easily shown.

As can be seen from the accompanying pictures, the base is a single block of wood, preferably plywood, of a size determined by the number of "tappets" and locking bars. Instead of cutting grooves for the cross locking bars, pieces of dimension lumber of suitable size such as 1 by 2, 1 by 4, etc., properly spaced, provide the cross locking channels.

The cross locking bars are strips of wood of a size which can slide freely in the crosslock channels, without being a "loose" fit. It is best to start with slightly oversize pieces and sand them to a nice fit. The cross locking bars, as well as the tappets, locking dogs and guide pieces should be sanded to a smooth finish. I prefer to use a hard wax finish on such devices rather than paint or enamel, thereby reducing the possibility of stickiness in the completed device. Also, these moving parts are best made of relatively hard wood, such as maple, to permit finer finishes and dimensioning, and better withstand use and handling.



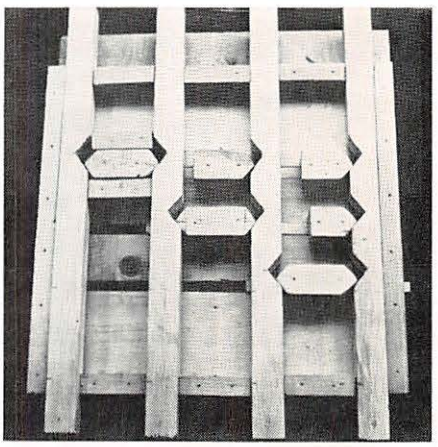
The demonstration locking bed is made of wood, in a large enough size to enable a physical study of the principles of mechanical locking during classroom training.

The tappets and the locking dogs are cut from rectangular strips of wood of appropriate width and height. Guide strips are also provided as shown. Cutting of the notches on the tappets and the noses on the locking dogs is readily accomplished by either hand or power sawing, followed by sanding to a smooth finish. Care should be taken to close dimensions, so that there is little "slop" or looseness in the locking.

Guides for the locking dogs are optional. Detents, stops or stop marks to indicate the limit of movement normal or reverse should be provided on each tappet. Pencil marks are adequate for this purpose, as well as for "lever" numbers.

Because the cost is negligible, a number of different sets of tappets and cross locking can be provided, to show increasing amounts of locking, to duplicate special locking conditions, and so on. "Swing" dogs, butt locking of locking bars, etc., can all be provided.

The model shown in the photos is arranged so that pulling any one of the tappets to the reverse position (toward the operator) will lock the other three tappets normal. This would be the case where each tappet was operated by an associated lever which governed one of a set of four home signals at a railway grade crossing. The locking which is shown is intermediate in development, and by using further butt locking in the locking bars, the necessary locking can be reduced to one locking channel, and three double-ended locking dogs. Such changes can be clearly demonstrated, as well as the unnecessary redundancy provided by "overlocks", etc.



These models employ the so-called "Style A" locking, but the same construction principles can be employed to illustrate Saxby and Farmer (S&F) locking.

Dimensions for the model shown in the photographs are as follows: Tappets 1 in. by ¾ in. high, spacing between tappets 3¼ in centerline to centerline. Side guides and front and rear tappet guides ¾ by ¾ in. Locking bars ⅜ in. wide by ¾ in. high. Locking bed 12 in. wide overall by 11½ in. deep. Base 12 in. wide by 13½ in. deep. This particular model was built, hurriedly, from scraps of No. 2 pine lying around the shop, in one evening's time, yet it has done its teaching job very well.

Innovative design created in the Brooklyn Bridge
a timeless structure as serviceable today as when it was opened
ninety years ago. Equally innovative designs maintain
Kerite's unique reputation for insulated electrical cables
that stand the test of time under the most demanding service
and installation conditions. Specify Kerite...the cable that lasts...
and lasts...and lasts...

MEMBER RPI

The Kerite Company • Principal Offices: Boston; Chicago; New York; Philadelphia; San Francisco; and Seymour, Connecticut • Sales Representation throughout the United States. A subsidiary of Harvey Hubbell Incorporated.

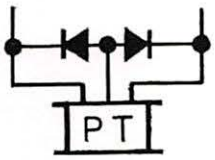
Kerite CAYS KERITE

1. Title: POWER OFF OR POWER TRANSFER RELAY

2. Definition:

Power Off Relay or Power Transfer Relay: A relay so connected to the normal source of power that the failure of such source of power causes the load to be transferred to another source of power.

3. Symbol:



4. Description:

Power off or power transfer relays are dc neutral relays with a half wave rectifier mounted externally and connected in parallel with each relay coil to provide dc current through the coils. The relay is available with two, four or six contacts. However, the most commonly used is the one with two contacts.

Figs. 1(a) and 1(b) illustrate two types of power off relays.

5. Purpose and Application:

Some signal installations have several lighting circuits, i.e., crossing protections. If commercial ac power is available it is the normal practice to light the lamp bulbs by ac to conserve on battery. Because commercial ac is subject to occasional outages it is necessary to ensure that during such outages that lamp circuits be transferred to an alternate source. The alternate or standby source is normally batteries.

The power transfer (PT) relay is the device employed to detect power outages and transfer the load to battery. The coils of the PT relay are connected to ac. The half-wave rectifiers mentioned in the description are mounted so that the current supplied to the coils is rectified ac. A description of the rectifying process is covered under Detailed Operation.

When the ac supply is intact the PT relay is energized. The lamp bulbs receive ac through the heel and front contacts of the PT relay. If the ac supply fails, the PT is de-energized. When the relay drops the heel makes with the backs. The back contacts are connected to the

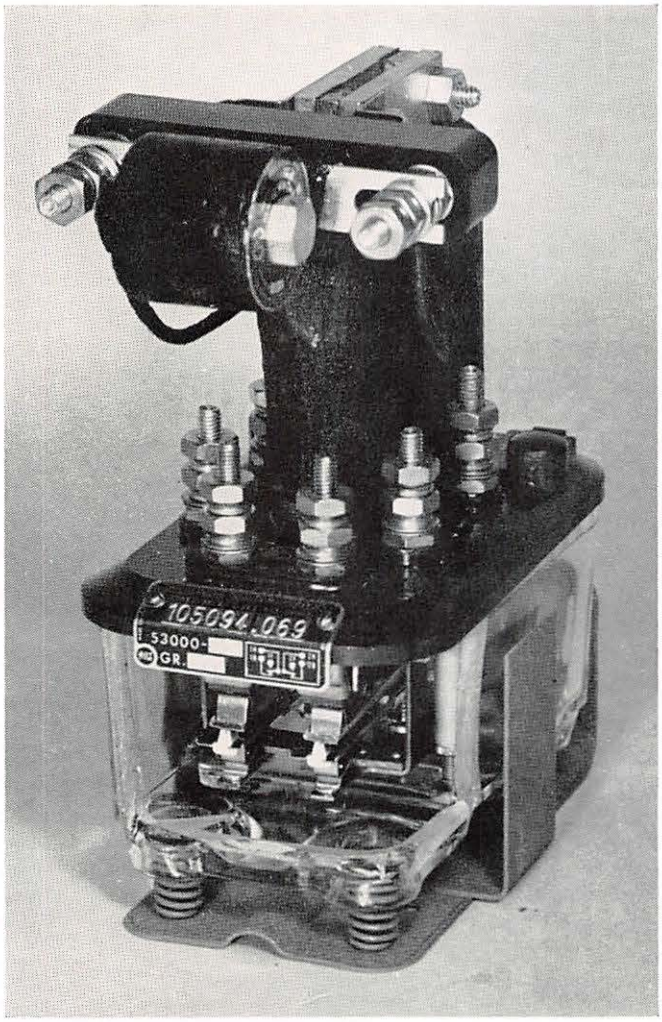


Fig. 1 (a)

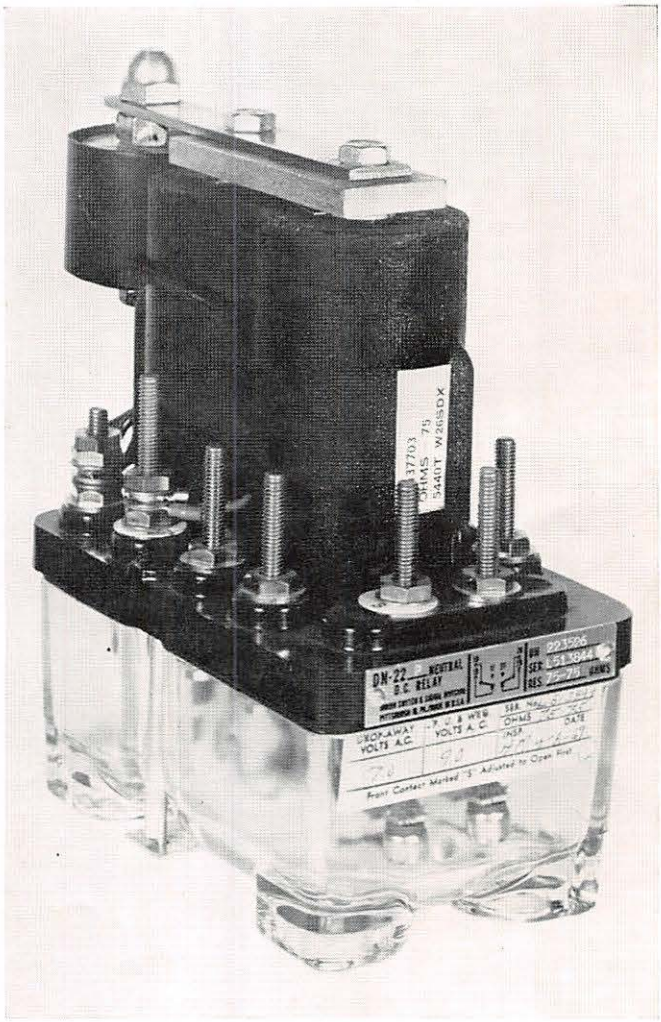


Fig. 1 (b)

standby supply, ensuring energy for the lamps. A typical circuit for the above is included under Detailed Operation.

6. General Information:

Some of the special features provided in power transfer relays are as follows:

Positive drop-away of the armature when the alternating current voltage has dropped to a predetermined value below the normal voltage. This provides protection against low voltage as well as loss of power.

A complete pick-up and drop-away, i.e., the relay will completely release to the de-energized position when the control voltage is reduced to the drop-away value. It will pick up to its full working position when the pick-up value of voltage is reached and will not assume a midway position on either pick-up or drop-away. This will prevent the armature from floating or hanging.

7. Detailed Information:

Figures 2 and 3 illustrate a typical control circuit of a power-transfer relay. The coils of the power-transfer relay are connected to the transformer secondary, which is a source of alternating current.

In Fig. 2 current flow through one coil of the relay during the first half cycle of ac is shown by the heavy dark line. Note that current flow is through one relay coil and that leg of the rectifier in parallel with the second relay coil.

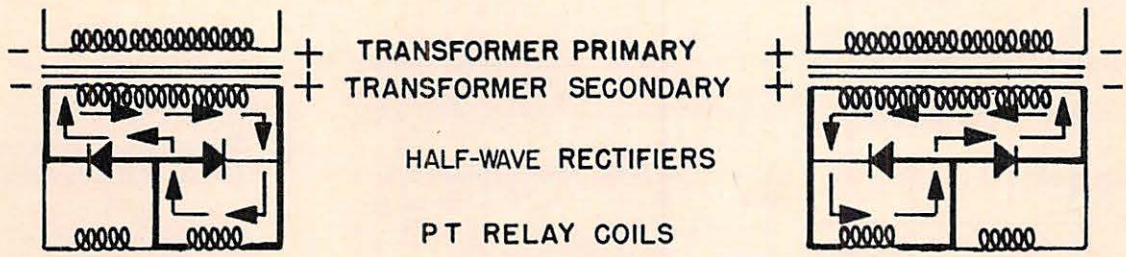


Fig. 2

Fig. 3

Figure 3 illustrates by the dark line the current flow through the other coil of the relay during the second half cycle. Not that current flow during the second half of the ac cycle is through the second relay coil and the leg of the rectifier in parallel with the first relay coil.

In Fig. 4(a) note that the power transfer relay coils are in parallel with the lighting circuit that is being energized from the secondary of the transformer via the front and heel contacts of the power transfer relay. If ac power is removed from the primary of the transformer, current will stop flowing in the secondary, thereby de-energizing the power transfer relay. Current flow to the light will then be from the standby battery via the back and heel contacts.

In Fig. 4(b) note that the power transfer relay coils are on a secondary winding other than that used by the lighting circuit. This is normally done when there are many lights or long cable runs which require the lighting secondary voltage to be set higher than the voltage allowable for use on the relay coils.

Figure 4(a) is a more desirable circuit because if the secondary winding should open, the relay will always be de-energized and the lights will be lit from the standby battery. Whereas, with scheme 4(b) there is a possibility of the lighting secondary opening up and the PT relay coils secondary remaining intact and the PT relay staying energized. With this situation the signals will not be lit, therefore the safety factor of the standby battery has been eliminated.

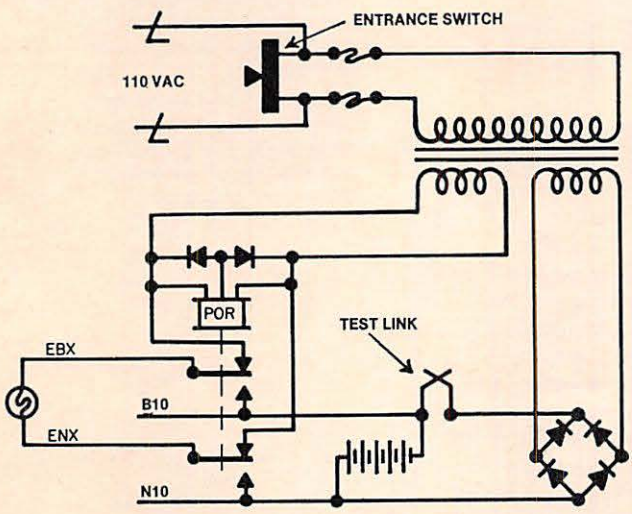


Fig. 4 (a)

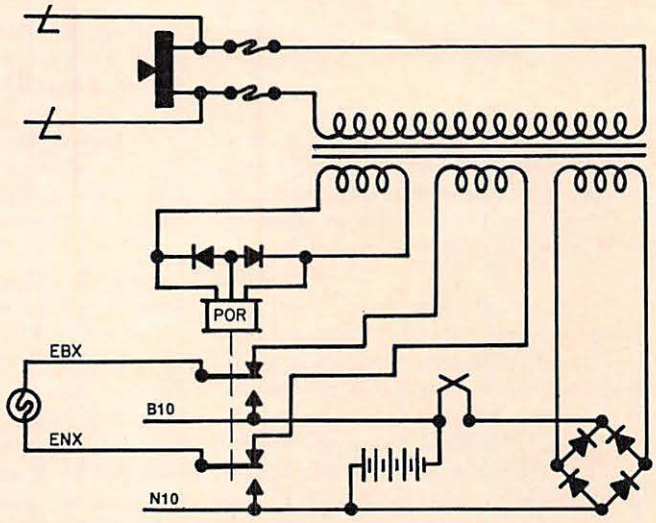


Fig. 4 (b)

People

OREGON PUBLIC UTILITY COMMISSION.—Richard Mather, former vice president of sales and engineering, **National Electric Control Co.,** has been appointed signal engineer, Railroad Division, OPUC. He will be working on PUC programs to upgrade safety at railroad-highway grade crossings throughout the state.

PENN CENTRAL.—Harvey Alexander, system engineer-communications and signals-maintenance, appointed chief engineer-communications and signals, succeeding **Joseph J. Eash,** who retired May 1, after 33 years in railroad engineering. **James A. Early,** engineer communications and signals-construction, succeeds Mr. Alexander. **John J. Cunningham,** engineer-communications and signals-staff, succeeds Mr. Early.

SUPPLIERS

Herbert C. Schwartz, senior consultant-reliability, **General Railway Signal Co.,** has been appointed to the American Public Transit Association's Special Task Force on Reliability, Availability, and Maintainability.

Frank G. Miller has been appointed vice president-industrial relations, **Transportation Systems Group** of **WABCO.** Previously director-industrial relations, Union Switch & Signal Division and Westinghouse Air Brake Division, Mr. Miller succeeds the late **Jack L. Mason.**

Arthur Holtzman, field engineering manager, **Servo Corp. of America,** Hicksville, N.Y., has been appointed district sales manager, railroad products, succeeding **Henry Talbert,** retired.

Richard A. Barkley, regional sales manager, **Ohio Steel Tube Co.,** a subsidiary of **Copperweld Corp.,** has been appointed marketing manager, **Copperweld Industries International, Inc.**

W. T. Goff appointed manager, South Central Region, **Safetran Systems Corp.,** Chicago, succeeding **C. E. Shepherd,** whose title has been changed to manager, Mid-West Region, Chicago. **Ronald Rudnicki,** sales and service engineer, Northern Region, Minneapolis, promoted to manager, North Eastern Region, Claymont, Del., succeeding **D. E. Emery,** assigned to other duties.

D. C. Ferryman, sales and service engineer, St. Louis, Mo. promoted to manager, Southwestern Region there. **A. J. Bennett** appointed manager, Canadian Region, Dollard Des Ormeaux, Que. Can. **P. L. Buttram,** sales and service engineer, Grain Valley, Mo., transferred to Louisville Ky.

Ronald W. Snee, proposal engineer, transit markets, **Union Switch & Signal** Division, WABCO, has been appointed product manager, vehicle control. He will be responsible for the marketing activities relating to train control systems and products.

Robert P. Lewis has been appointed manager of microwave sales, **Granger Associates.** He was formerly international sales manager, Menlo Park, Calif.

Elvin R. Beck, field engineer, Edison Battery Division, **McGraw-Edison Co.,** Bloomfield, N.J., has been appointed manager-rail transit.

Richard A. Barkley, regional sales manager, **Ohio Steel Tube Co.,** a subsidiary of **Copperweld Corp.,** has been appointed marketing manager, **Copperweld Industries International, Inc.**

Robert D. Falconer has been appointed assistant manager-advertising and sales promotion. **Sola Basic Industries,** Milwaukee, Wis.

E. G. Scheer has joined the Telephone Products Department, Electronic Instrumentation Division, **Lear Siegler, Inc.,** as a senior sales engineer with responsibility for the states of Texas, Oklahoma, Arkansas and Louisiana.

Albert R. Wartchow has been appointed sales representative—Milwaukee district, **Okonite Co.**

William S. Crawford has been named director of export sales, **General Cable Export Corp.,** subsidiary of General Cable Corp., Greenwich, Conn.

Larry W. King has been promoted to general sales manager-magnet wire, Wire & Cable Division, **Anaconda Co.,** Glen Ellyn, Ill. Mr. King was formerly district sales manager, magnet wire, Cincinnati. **Rhea Doyle,** area sales manager for Anaconda power cable products, has been appointed southeast district manager-magnet wire, Wire & Cable Division, with headquarters as before at Memphis, Tenn.

Which

Only

Progress in electronic hot box detector systems

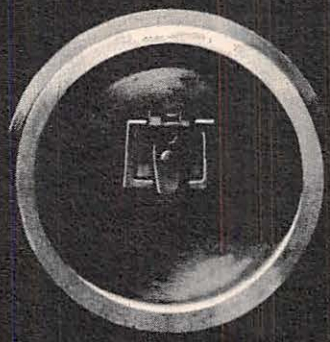
The "Decision-Maker" Universal Alarm System brings the state-of-the-art in hot box detection to a new high level. And that's just what you'd expect from the No. 1 company in the field—Servo, the industry's pioneer designer and leading producer.

Since 1957, more than 1,800 SERVOSAFE Hot Box Detective Systems have been put into service world-wide, and have compiled an unequaled record of safety improvement, more efficient preventive maintenance procedures and cost reduction.

Hot box detectors available from Servo offer the widest flexibility in choice of system configuration, features and functional options. With our broad range of products and world-traveling network of field engineers, we can readily "customize" the design, manufacture, installation and operation of a SERVOSAFE System to best meet the particular requirements of your railroad.

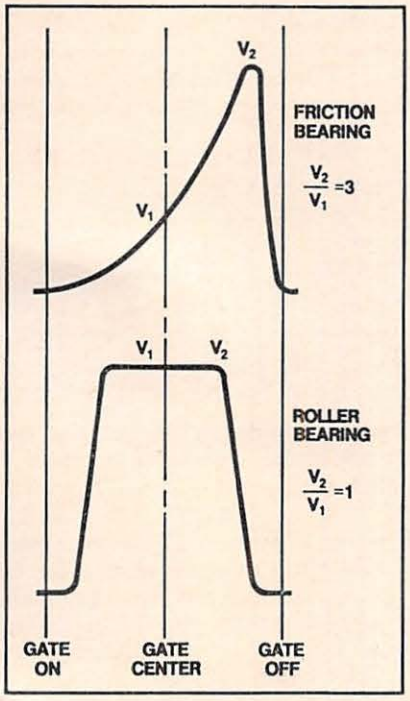
You are invited to contact us for complete descriptive literature, or to arrange a field engineering site survey and application review—without obligation, of course.

bearing has the hot box? the "Decision-Maker" knows!



Servo's new Universal Alarm System with automatic bearing identification*

The heart of our new Universal Alarm System is a unique bearing identification circuit known as "SWAT"—Split Waveform Analysis Technique. Because of their different heat transfer characteristics, roller and friction bearings produce different heat radiation "signatures" during the detector scan period. The SWAT circuit splits the gate scan period and compares V_1 with V_2. Typically, friction bearings produce a V_2/V_1 ratio of approximately 3, and roller bearings produce a ratio of approximately 1. The ratio sensed by the system is utilized to identify the type of bearing being scanned.



The "Decision-Maker" Universal Alarm is much more than the latest development in SERVOSAFE® Hot Box Detective™ Systems. It's a whole new concept designed to solve one of the toughest problems in hot box detection: **the difference in heat level characteristics between roller bearings and friction bearings.** The fact that normally-operating roller bearings run hotter than friction bearings has always presented a serious dilemma to railroad engineers. If you employ a low level alarm setting for early detection of overheated friction bearings, you run into the problem of too many false alarms on roller bearings. A higher setting to be consistent with roller bearings is not recommended as it can result in overheated friction bearings that pass by undetected.

Now, you don't have to make that difficult decision. Our new "Decision-Maker" Universal Alarm System will make it for you. It provides individually adjustable differential and absolute alarm levels for each type of bearing. It automatically distinguishes between roller and friction bearings, applies the proper alarm level, and actually makes the decision as to whether or not a hot box condition exists.

The Universal Alarm is available on new installations or as retrofit equipment for all existing models of SERVOSAFE Hot Box Detective Systems. If you'd like to put an end to the roller bearing vs. friction bearing problem, let us put the "Decision-Maker" to work on your railroad. Write or phone today for complete information.

*PATENT PENDING

servo

SERVO CORPORATION OF AMERICA
Hicksville, New York 11802
Phone 516-938-9700 • TWX 510-221-1872
1009 Pully (Lausanne) Switzerland
Phone (021)29-98-73 • Telex 24 420 SERVO CH
Rio de Janeiro, Brazil
Phone (235)52-56 • Telex 30-9121 PB Rio

MEMBER RPI

Information Systems for Efficiency and Safety

Circle 6 on Reader Service Card.

Problems and techniques in the use of audio frequency track circuits

Many of the problems confronting the users of audio frequency track circuit equipment are common to DC track circuits to some extent, but are more significant in audio frequency systems. These problems have been recognized many times. Yet, until recently, little effort has been made to document the solutions to many of the common and uncommon problems confronted by the signal engineer and signal maintainer. The following article, presented by Robert E. Harmon, president of Harmon Industries, at the recent Northern Sectional Meeting of the Communications and Signal Section, Association of American Railroads, held in Winnipeg, Man., Can., cites some typical examples of track circuit interference and limitations. Mr. Harmon goes on to offer some sound techniques for solving and preventing these problems, along with a few pointers for maintaining and troubleshooting the equipment.

Since the invention and installation in 1872 of the first DC track circuit by Dr. William Robinson at Kinzua, Pa., many innovations have been instituted. The original form of DC track circuit is still in widespread use today, but in some applications is being discontinued in favor of electronic track circuits. Two suggested advantages of audio frequency track circuits are:

1. The overlapping of two or more track circuits without the use of insulated joints and repeating relays.
2. The elimination of insulated joints at adjoining track circuits due to separation by frequency and/or modulation.

In some applications, the use of audio frequency track circuits results in a substantial cost savings. Studies have been made to determine the annual cost of maintaining insulated joints. Many railroad managements consider they are able to effect cost savings with the use of audio frequency track circuit equipment. However, these cost savings are not necessarily straight across-the-board savings. Audio frequency track circuits are more complex, if only by the sheer number of physical components, and have limitations that should be understood and considered during circuit design.

It is not my intention to delve into track circuit design details, but to bring to your attention at this time (when your managements are pressing for cost savings) a few precautionary measures to avoid being saddled with circuits that are less than satisfactory.

The general problem areas confronting the users of audio frequency track circuit equipment are:

1. Rail impedance.
2. Ballast resistance variations.
3. Interfering signals.
4. Lightning damage.
5. Complex testing procedures.

Most of these are common to DC track circuits to some extent, but are more significant in audio frequency systems. Let us explore each of these problem areas in some depth.

First we will consider rail impedance. Despite their large size, rails have both considerable resistance and inductance, varying with size, temperature, current and frequency of the track circuit. On the average, a 100 lb rail has a DC resistance of about 0.01 ohms per 1,000 ft. The DC loop resistance of 1,000 ft of track would then be about 0.02 ohms and is inversely proportional to the weight of the rail. Usually, 0.03 ohms is used to calculate the loop resistance of 1,000 ft of bonded track. The AC loop impedance is considerably higher because of the inductance of the rail which has no effect on DC.

Typical values of loop impedance per 1,000 ft of track would be as follows:

DC	0.03 ohms
60Hz	0.2 ohms
1,000Hz	2.6 ohms

The importance of impedance becomes apparent when you compare the loop resistance of a DC circuit with that of a 1,000Hz circuit. A very significant portion of the total circuit impedance is now in the signal path.

Audio frequency track circuits, even with the addition of impedance, would be simple were it not for ballast resistance variations. Most of the leakage appears from each rail to ground, although a small percentage is through or across the ties or surface. Since there is no way that we can adequately control these variations, we will have to live with them. It would be well then, at this point, to look into the effect of these variations to determine what we can do to make living with them as free as possible from unwanted maintenance calls and prevent failures due to the inability of the equipment to function properly under these variable conditions.

Because these variations do exist, one approach is to design the input impedance of track circuit receivers at a very low value. In so doing, we load the rail at the frequency involved to a value simulating extremely poor ballast. Other frequencies are not loaded significantly because of the tuned input circuitry. However, because of the impedance of the rail this loading has some limitations. To illustrate this, Fig. 1 represents the impedance and loading of a typical 1KHz track circuit 1,000 ft long, assuming a very high ballast resistance. A similar DC track circuit is also shown for comparison.

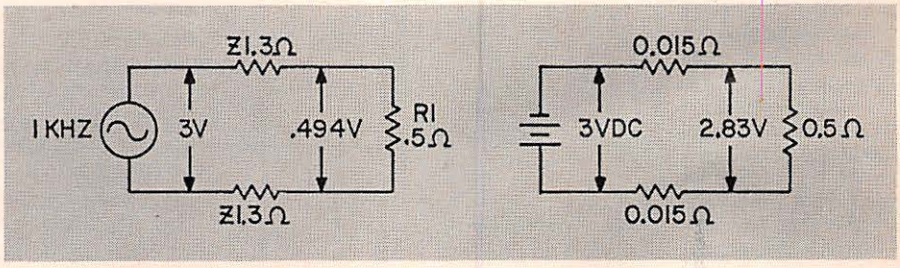


Fig. 1—Representative circuits comparing the impedance and loading of a typical 1,000 ft. long 1KHz track circuit (assuming a very high ballast resistance) with a similar DC track circuit.

With 3.0 volts AC output from the transmitter, we find 0.494 volts at the receiver terminals. With 3.0 volts DC applied to the rail, a voltage of 2.83 volts DC appears across the termination load.

Again, with simple representative circuits (Fig. 2) let us look at the variation caused by ballast conditions at 0.5 ohms per 1,000 ft. of track.

As you could have predicted, the AC voltage at the receiver terminals is down approximately 6db. The DC voltage only dropped from 2.83 to 2.585 volts.

With typical receiver sensitivities of 0.005 volts, this is still much more signal than that required to energize the receiver. The problem then can be seen

that if receiver adjustments were made under the conditions of the high ballast resistance and conditions then degraded to that of the 2 ohm ballast, the receiver could possibly be de-energized without a shunt of any kind applied to the track. To minimize this problem, we should:

1. Keep the frequency as low as possible.
2. Keep the circuit as short as possible.

The reverse can also be true where it would be difficult to shunt the circuit with a 0.06 ohm shunt. Under these conditions, a train will still generally cause shunting as the shunting effect of a train is much better than that of wire shunts unless rail conditions are very poor.

In an area with two or more crossings utilizing audio frequency equipment, it is difficult to keep all the frequencies below 1KHz. And, as the distance of the circuit is determined by train speed, that too is not something that can be easily controlled. Such installations frequently use many different frequencies, some of them traveling a greater distance than would normally be used under conservative design practices. The result is an increasing potential for interference among channels. With the advent of mudulated audio frequency equipment, this problem is eased somewhat. As the security of the system is largely in the modulation, less stringent physical separation requirements can be observed when re-using the same frequencies but with different modulation rates.

An important aspect of audio frequency track circuits is the possibility of interfering signals generated by a multitude of sources. The most common source of interfering signals is that of the heterodyning of two or more signals on the rail causing the creation of an unwanted signal. This is particularly undesirable if non-modulated equipment is utilized, as the interfering signal can cause an unsafe condition. As an example, visualize a condition where the frequencies in Fig. 3 are involved.

The combination looks innocent enough until you start to do some simple arithmetic, i.e., Primary 1.5 – Primary 1.0 = Beat Frequency .5. Primary 4.0 – Beat Frequency .5 = 3.5. Under these conditions, we have two sources of the 3.5 signal. And, if for some reason the 3.5 receiver has to have the sensitivity adjustment near maximum, we may have created an unsafe condition. A shunt placed on the rails at the 3.5 transmitter may not cause sufficient shunting at the receiver to assure that the receiver will remain de-energized.

A measure of protection is added with the use of modulated equipment. However, it is also possible, under certain conditions, to generate unwanted modulated signals in the same manner. Take the above frequencies and add subtones (either AM or FM) as follows: 1.5 @ subtone A, 1.0 @ subtone B, 3.5 @ subtone C, and 4.0 @ subtone C. Now let us do the same arithmetic as above and this time add to subtones. Primary 1.5 @ A – Primary 1.0 @ B = Beat Frequency .5 @ AB. Primary 4.0 @ C – Beat Frequency .5 @ AB = 3.5 @ ABC. We again have the necessary frequency and subtone component to falsely energize the 3.5 receiver. The best answer we have found to this problem is to assign a different subtone to each channel and still avoid conflicting combinations of primary frequencies as much as possible.

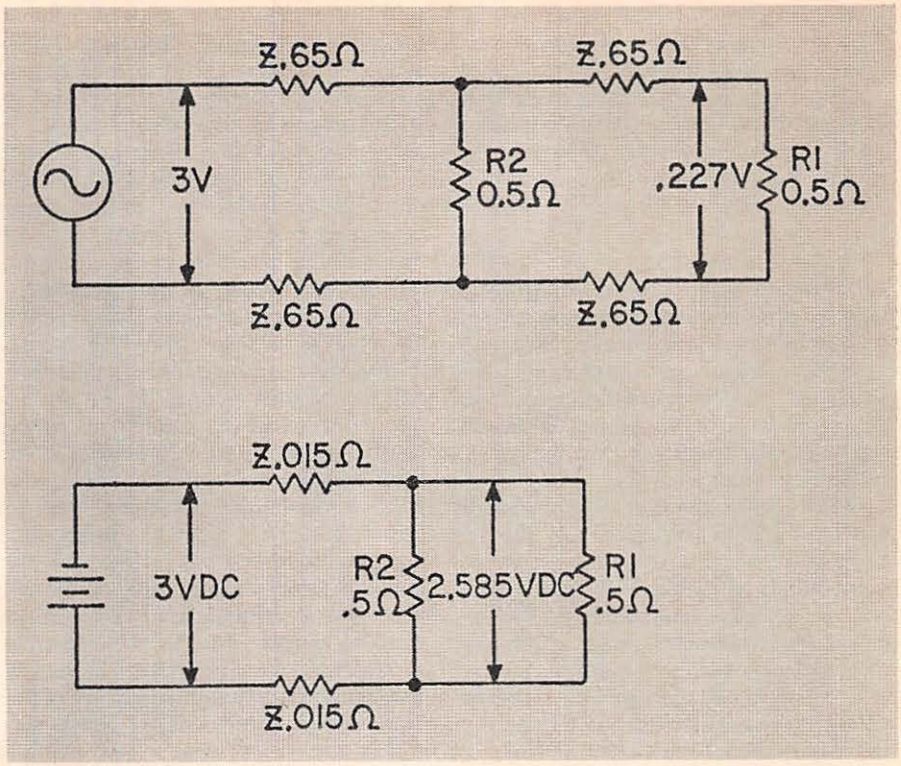


Fig. 2—Ballast conditions of 0.5 ohms per 1,000 ft. of track cause the AC voltage at the receiver terminals to be down about 6db. For comparison, the DC voltage only dropped from 2.83 to 2.585 volts.

Other possible sources of interference include 60Hz and harmonics of 60Hz which could beat or heterodyne with other sources to produce an undesired signal. Non-modulated systems are more susceptible to this type interference as it is all but impossible to create an interfering FM signal unless one of the parent sources is frequency modulated.

Arcing of catenary trolleys and third-rail contactors produce a considerable amount of random signals in the rail. During acceleration from a stopped condition, the signal introduced into the rails may be sufficient to energize a non-modulated receiver or to swamp out a modulated one. True, it takes an application of Murphy's Law [If anything can go wrong, it will.] to set up this condition; but we all know that Murphy works overtime on the railroads!

We find that with judicious use of frequencies, very substantial savings can be safely realized with audio frequency equipment. Considerable effort

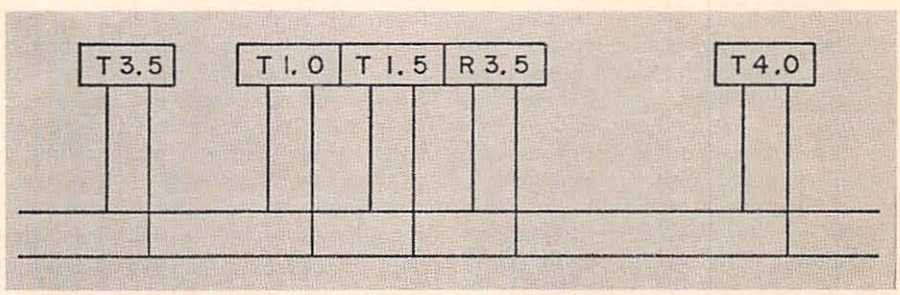


Fig. 3—The most common source of interfering signals is that of the heterodyning of two or more signals on the rail causing the creation of an unwanted signal.

is being expended by all suppliers of audio frequency track circuit equipment to improve the immunity to unwanted interfering signals.

Up to this point, I have dealt only with the limitations of audio frequency track circuit equipment. Knowing the circuit limitations is only half the battle. Maintaining the equipment after installations has areas of concern, too.

Let us assume that you have a circuit failure. What procedures do you take to properly determine the cause? Assuming, also, that you have the proper input voltage and wiring intact, you are faced with the question of whether the receiver is inoperative, the audio signal is insufficient, or that the transmitter is inoperative.

While at the receiver, it is desirable to determine the amplitude of the incoming signal. If a frequency selective voltmeter is available, connect the frequency selective voltmeter to the receiver input terminals and read the signal level. A varaition of approximately 2:1 or 6db in voltage could be expected from a dry to wet condition. If the signal were down by a factor of 10:1, or 20db in voltage or more, from normal, a shorted/open track condition or defective transmitter would be indicated.

If the signal level was within the normal variation, a defective receiver could be indicated. If very little sensitivity adjustment was required to energize the receiver, consider the possibility of previous adjustments being incorrectly made. For instance, if the receiver was adjusted, when dry, to what was thought to be a 0.06 ohm shunt, but was actually 0.15 ohm, a variation of 2:1, or 3db in voltage, could well cause an inoperative receiver. The use of shunts equipped with files or giant alligator clips will often result in poor contact with the rail and could produce the foregoing incorrect setting.

Realizing that there are still many who do not have frequency selective voltmeters to determine signal levels, other procedures need also to be covered. This is somewhat more complicated, in that outside of complete failure of transmitter, receiver or track circuit, a gray area prevails where you must determine the cause of failure based on assumptions.

If, for instance, you can energize the receiver with a minor increase in receiver sensitivity, you can assume that the track conditions varied more than normal; or that perhaps the previous adjustment was incorrectly made. If the receiver cannot be energized with a minor increase in sensitivity, the transmitter can be checked for proper output power. Transmitter output power can be checked with a standard voltmeter by measuring the voltage at the output terminals directly, if there are no other AC signals in close proximity, or by removing the rail connections and substituting the proper output termination load resistor and reading directly across this load. The artificial load method is preferable, particularly with low-power transmitters, as it negates the possibility of reading foreign or induced AC currents. If the transmitter is producing the proper output voltage, it may be necessary to substitute another receiver at the same frequency or another complete system.

All this has taken considerable time, and you have now vowed to have a frequency selective voltmeter on hand before the next failure. To be sure, a frequency selective voltmeter is a very helpful piece of test equipment. It will read signal levels on the rail at any point between the transmitter and receiver, detect the presence of modulation, locate defective insulated joints, bonds or couplers, and, in general, save you a lot of valuable time. However, a word of caution is in order when using a selective voltmeter with FM signals. One popular model (which many of you now have) has only a 25Hz bandwidth, which can result in a low reading when reading FM signals above about 1250Hz. A 1% frequency shift of frequencies above 1250Hz will result in a signal bandwidth of more than 25Hz. To read the true power level on the rail, the modulation of the transmitter can be defeated. Normally, this will result in a 1% or more frequency shift, either up or down, depending on how modulation is accomplished. Power levels will remain unchanged as the transmitter is broad enough to transmit full power at maximum frequency shift.

I would be remiss if I did not at least speak briefly about the problem of inductance coupling of the transmitter energy direct to the receiver at locations where the transmitter and receiver are co-located, and the leads are buried in a portion of the same trench. Island circuits, electric locks and motion detectors would be typical of this.

A few years ago, it was the mark of a good workman to neatly lay the track cables parallel in a trench and to coil the slack under the case at the base of the riser pipe. Under these conditions, the transmitter and receiver leads are coiled together. When a train shunts the rails, the wire then acts as a transformer; and energy is induced directly from the transmitter to the receiver leads. Sufficient energy can be induced under these conditions to cause the receiver to be energized while a train is on the circuit.

A simple, yet effective, test for this condition is simply to observe, during train passage, that the receiver will not become energized when adjusted to maximum sensitivity. A more accurate method of determining the amount of induced coupling is with the use of a frequency selective voltmeter. A train will normally shunt the signal to level below −60db which is far below the maximum sensitivity points of most receivers. Existing track leads that measure induced coupling well below the maximum sensitivity of the receiver are safe to use as long as the leads are not disturbed. If dug up, it would be advisable to replace with twisted leads.

A more recent development in audio track circuit equipment has been the motion detection devices that have been put on the market by several manufacturers. These devices were developed primarily for the following two reasons:

1. To provide a method of improving credibility of warning devices at grade crossings by eliminating unnecessary operation.

2. To provide a more economical installation by avoiding costly approach locations and logic circuits.

These devices have generally been successful in solving the above mentioned problems, but themselves have created some additional areas of concern.

1. It is generally difficult to simulate a moving train at all speeds to see the device operate under all modes without the use of a test train.

2. Some degradation of look distance is usually observed with deteriorating ballast conditions.

3. The devices can be fooled by an inadvertent shunt left behind the train on the approach.

4. Detection of high resistance bonds or broken rails can be a problem especially at the extremes of the approach.

We generally counter these potential problems with the following rationale. We suggest that no installation be installed or serviced without seeing an actual train movement, preferably at the maximum speed to verify warning time. The degradation in look distance usually doesn't exceed 10% to 20% so where possible lower frequencies should be used if low ballast conditions are anticipated.

Inadvertent shunts can actually be less of a problem with motion detection devices than with conventional DC or audio overlay stick circuits. You will generally have some warning time in contrast to no warning time with a lockout. Various methods such as low signal detectors can help but not eliminate the problem of detecting high resistance bonds and broken rails. First we have to define what is a high resistance joint or a broken rail electronically, and then if we do detect a marginal situation we have to use care in not readjusting the device to overlook this problem. A DC wrap around has been a popular way to eliminate some of the fears of many signal people.

In general, when these devices are

properly applied, realizing they are not the answer to every grade crossing problem, they do an excellent job in increasing credibility and saving money.

Much has been said and written in the past few years about preventing lightning damage. Our recommendations to minimize this damage are as follows:

1. Twist track and battery leads.
2. Keep battery leads as short as possible.
3. Run battery lead of each unit back to battery buss.
4. Locate receiver and associated relay as close together as possible.
5. Connect the ground terminal to the signal case as directly as possible. Avoid sharp bends in this lead.
6. Signal case should be grounded for personnel protection.
7. Surge arrestors on both battery and rail should connect directly to the signal case.

There are, without doubt, many more areas to be covered when dealing with audio frequency track circuit equipment.

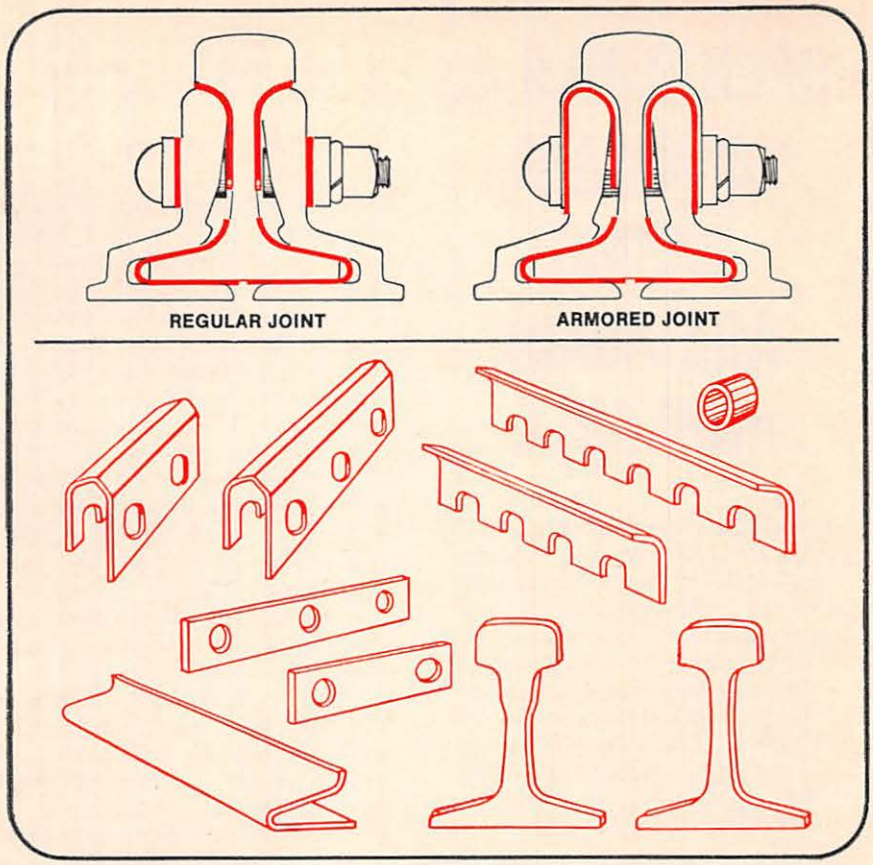
The secret to our ability as suppliers and railroaders to solve audio frequency track circuit problems lies in our ability to think "AC."

Publications

A new Disc Pack/Cartridge Management Handbook that describes the most effective methods for the cleaning, care and inspection, handling and storage of disc packs and cartridges is available from Computer-Link Corp. The 8-page brochure deals with such subjects as processing newly received packs and cartridges, handling procedures, routine care and inspection, the detection of trouble conditions, recording levels and cleaning procedures. In addition, a descriptive section on the company's line of disc pack and cartridge cleaners and inspectors and other products is included. *Computer-Link Corp.*

Circle 101 on reader service card

The advantages of digital control closed circuit television over conventional control systems are described in a concise, new brochure titled "Digital Control of Closed Circuit Television". The 4-page booklet contains informative graphs depicting the cost-factors of conventional multiconductor systems as compared with digital systems. Included is an analysis of the methods which provide the greatest dollar for dollar value. Various options available, methods of system expansion



Complete track insulation sets or bulk components...

ORDER THEM DIRECT FROM NVF

Precisely-fabricated Forbon® vulcanized fibre track insulation can now be purchased directly from NVF at manufacturer's prices. NVF, world's largest manufacturer of vulcanized fibre, has been making fibre track insulation for nearly 70 years and servicing you through leading railroad suppliers.

Vulcanized fibre is by far the most widely used material for track insulation because:

- Forbon provides the best combination of serviceability and cost of any material used for rail joint insulation.
- Forbon reduces renewal costs through simplicity of installation and lower material costs. Forbon insulation can be supplied in sets for complete joint replacement or as individual components to replace only those parts that are worn.
- Forbon is tough and lightweight. It is highly resistant to friction, high and low temperature extremes, oils and compression flow.
- NVF manufactures not only the parts, but the material itself, and exercises rigid quality control over every phase of the manufacturing and fabricating processes.

Since bushings and end posts are the points of maximum stress in a joint, NVF has developed special filament-wound steel bushings and reinforced nylon end posts which greatly extend the life of the insulated joint.

Your rail joints are most likely insulated with Forbon now. Keep them that way at the lowest possible cost. Contact J. H. Haley at NVF for immediate action and service.

NVF COMPANY
Railway Products Group
YORKLYN, DELAWARE 19736 • 302/239-5281

Circle 7 on Reader Service Card.

OPERATIONS & SIGNALING BASICS ARE AGAIN AVAILABLE

RAILROAD OPERATION AND RAILWAY SIGNALING: The basic text which explains the relationship between train operation and railway signaling is now available in reprint form. The text is in the form of questions and answers so that the reader may know the objective of the information given, and to place emphasis upon the "why" and "how" of railway signaling and railroad operation.

Topics covered include fixed signals, block signaling, interlockings, centralized traffic control, cab signals and highway grade crossing protection. This is a reprint of the 1953 edition of RAILROAD OPERATION AND RAILWAY SIGNALING by Edmund J. Phillips, Jr., Simmons-Boardman Publishing Corp., 350 Broadway, New York, N.Y. 10013. Softbound. Price: 1 to 9 copies at $5.95 each; 10 or more copies at $5.00 each. To obtain copies, please fill out the coupon and send check or money order along with your order.

Simmons-Boardman Publishing Corp.
Book Department
350 Broadway, New York, N.Y. 10013

Gentlemen: Enclosed is $_____
Please send me the following:
_____copy (copies) of Railroad Operations & Railway Signaling.

(1 to 9 copies at $5.95 each; 10 or more copies at $5.00 each).

Name _____

Title _____

Company _____

Address _____

City _____ State _____ Zip _____

and the added featured and capabilities of digital control are also explained. *Motorola Communications & Electronics, Inc.*

Circle 102 on reader service card

The new 32-page IEEE Standards 1975 Catalog is now in print. The catalog lists more than 350 standards publications by subject as well as in numerical sequence. Included in the set of listings are the many American National Standards published by IEEE. Standards developed within the Institute of Electrical and Electronics Engineers cover test methods, practices for electrical installations, units, definitions, graphic symbols, letter symbols, and applications methods. Engineers in such widely varied fields as antenna design, communications, power generation and distribution, microwave measurement, industrial applications, electromagnetic compatibility, and rotation machinery will find many authoritative documents that have received recognition both nationally and throughout the world. *Institute of Electrical and Electronics Engineers.*

Circle 103 on reader service card

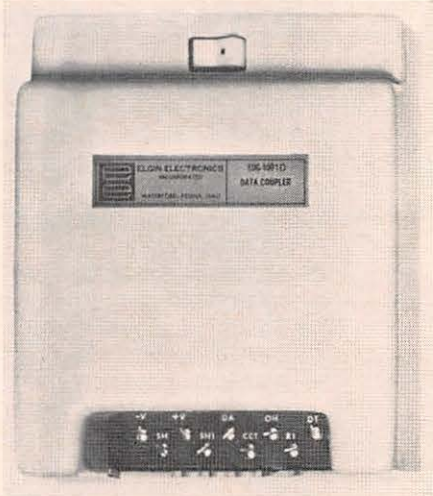
A 12-page catalog about crimping tools is now available. The catalog contains information about the manufacturers maintenance and crimping pliers, hand ratchet and rotary-nest tools, and air powered tools. Also described is an automatic crimping machine which is said to crimp up to 3600 tape-mounted terminals per hour. *Hollingsworth Solderless Terminal Co.*

Circle 104 on reader service card

A 20-page technical bulletin providing complete information for the type 262A 4800 bps Data Set has been made available by GTE Lenkurt. Transmitting and receiving synchronous 4800 bps serial binary data, the 262A Data Set operates over unconditioned type 3002 channels to process data from terminal equipment such as business machines, computers, instrumentation systems and cryptographic equipment. Capable of half-duplex or full-duplex operation over privately owned or leased transmission facilities, the 262A is particularly suited for point-to-point and multipoint polling system applications. *GTE Lenkurt Inc.*

Circle 105 on reader service card

Product News



New data coupler protects equipment

Model EDC 1001D is an automatic data coupler for connecting customer-provided automatic data equipment to switched telecommunications networks for data communications. The coupler provides both the Data Access Arrangement and the Network Control Signaling Unit as described in appropriate tariffs. The uniform service code for the coupler is CBT. Designed to isolate customer equipment to protect telephone plant and personnel, the unit also assures protection of equipment from metallic and longitudinal surges in excess of 50 volts occurring on telephone facilities. Other features include automatic linear control of signal levels above specified thresholds, plus the capability to detect incoming ringing signals to permit customer operation in unattended answering mode. *Elgin Electronics Inc. Circle 106 on reader service card*

Battery charger features low EMI operation

A new line of single-phase chargers for communications applications is being introduced by C&D Batteries. The new AutoReg Series ARK controlled ferro-resonant float chargers are said to offer low-cost operation through a combination of high efficiency and high power factor. The chargers are designed to greatly reduce electrical noise and electromagnetic interference (EMI). In addition, they offer DC voltage regulation and short circuit protection.

DC voltage is said to be maintained within ±½% from no load to full load, with ±10% variation in AC input volt-

(continued on page 28)

50 YEARS AGO IN

Railway Signaling

Vol. 18 MAY, 1925 No. 5

Responsibility of Manufacturers and Railroads for Signal Performance

The manufacturers of signal and interlocking apparatus are probably more vitally concerned in the mechanical integrity and operating efficiency of their devices than the railroads themselves. The manufacturer has the reputation of his organization to maintain and he knows from sad experience that if his product does not meet the requirement of railroad service they will lose prestige. In order to construct apparatus satisfactory to the railroad man, the manufacturers have seen fit to gather a large proportion of their engineering personnel from the ranks of the railroads. The manufacturers also follow their product into the field to offer their assistance in checking up on its operation and service. Then too these manufacturers are glad to secure comments and suggestions from railroad men regarding improvements in design or construction. Because of these facts, the majority of the railroads select and install signaling and interlocking as offered by the manufacturer.

In years gone by there has been a tendency on the part of some of the committees of the Signal section to change specifications slightly here and there, forever keeping the manufacturer in uncertainty whether he is using the correct size of screws or bolts, etc. However, the Signal section as a whole is now rapidly broadening out the scope of its work to include the study of ways and means of increasing track capacity by signals, of producing economies by installing interlocking and like problems. As a result the manufaturer is, and justly so, now left more alone in bringing his product to a point of standardization, permitting more economical manufacture, which saving will in time be passed on to the users.

Standardization of universally used parts is very commendable and should be carried out whenever practicable. However, the carriers might well accept the completed signaling units as produced by the manufacturer without too detailed special specifications for the individual user. The maker's responsibility for the correct performance of the product will insure the integrity and performance of equipment.

* * *

Light Signals, Color, Position or Color-Position

According to information furnished by the railroads 1,964 light signals were installed in 1924 as compared with 1,843 semaphore signals. These figures are evidence of the rapidly growing preference for the light signal for both day and night indication. Some roads, although using light signals for automatics, prefer the semaphore for interlocking signals, while others are using light signals for both the automatic block and interlocking.

With this tendency to adopt light signals it is interesting to note the different types and indications that are being developed and promoted. Of the 1,964 light signals installed last year, 1,600 were the color-light type and 364 were the position-light type. The color-light type has several variations of which the three-indication type with the lights arranged in a vertical row was installed in the greatest numbers. For example, the Great Northern installed 298, and the Illinois Central 240. Another variation of the color-light is the so-called searchlight unit, using the one light unit with a change of color, there being some 354 of this type installed by the New York Central last year. At interlocking where close spacing of signals on a pole is required two arrangements of color-light units are being used, one with the lights spaced in a triangle instead of a vertical row, while another idea, as explained in an article elsewhere in this issue, is to arrange the three color units in a horizontal instead of a vertical row.

The position-light signal as developed on the Pennsylvania has been adopted by some other roads; the Norfolk & Western installed 204 and the Lehigh Valley 56 of this type in 1924. Recognizing the advantages of both the factors, position and color for a signal indication, the Baltimore & Ohio has standarized on the color-position-light signal, and has recently ordered equipment for a large installation of this type of signals.

In this gradual change from the semaphore to the light signal three factors must be considered by those developing and installing such equipment; first, reliability; second, the quality of the indication to the engineman; and third, economy of maintenance and operation. Neglect to give any one of these due consideration may result in a failure of that type of signal being used extensively.

* * *

. . . MANUFACTURERS REPRESENTATIVES WANTED . . .

RAILWAY AGE is compiling a Directory of Manufacturers Representatives. Manufacturers, both national and international, in need of specialized representation frequently ask us for references. We would like to be able to give them your name.

So you may be a part of this important listing, please fill out and return to us the below:

NAME _____ PHONE _____

ADDRESS _____, _____, _____ (zip) _____

Area(s) of representation:

Mechanical ___: M/W ___: SIGNALING ___: TRANSIT ___

Directory of Manufacturers Representatives, Railway Age, 350 Broadway, New York, New York 10013

WHeeLCRACKS?

Every railroad has them, sooner or later.

WHeeLFACTS?

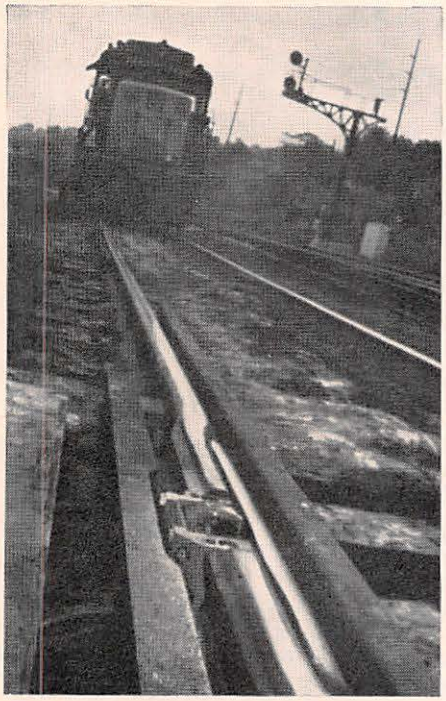
Every railroad needs them to locate and remove cracked wheels from service before failure causes an expensive derailment.

WHeeLFAX™

AUTOMATIC!

The In-track, In-motion Automatic Ultrasonic Inspection System For Railroad Locomotive and Car Wheels At Speeds To 30 Miles Per Hour!

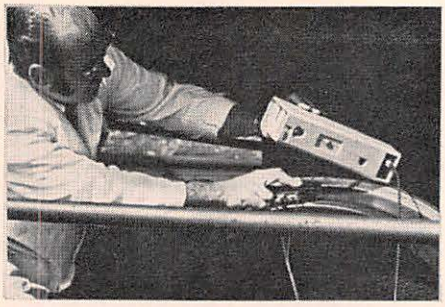
WHeeLFAX provides a permanent record of test results on every wheel passing over the System.



NEW! NOW!

WHeeLFAX JR™

MANUAL!



SCANNING SYSTEMS, INC.
210 S. KING ST.
DANBURY, CONN. 06810
203/748-2065

Circle 9 on Reader Service Card.

Product News

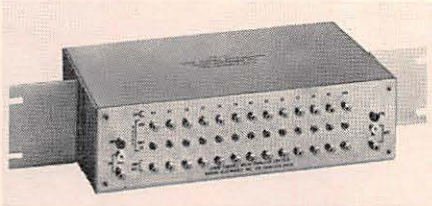
(continued from page 26)

age, ±5% frequency variations from 60 Hz, while floating the rated number of cells minus one, or plus one.

When connected to a battery with an 8-hour capacity rating equal, numerically, to four times the charger current rating, the electrical noise level is said to be typically 21 to 23dBrnC. Electromagnetic interference is said not to exceed the broad band limits of MIL-1-6181D.

During operation, the maximum voltage transient is said not to exceed 5% of the initial steady state voltage for sudden load changes between 20% and 100% of rated output. Recovery takes less than 200 milliseconds and all transient behavior disappears in 500 milliseconds. *C&D Batteries.*

Circle 107 on reader service card

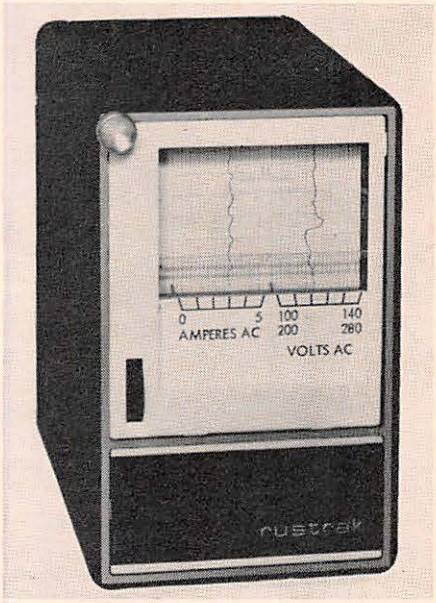


New equalizer is made for 60 kHz to 108 kHz range

A new Group Variable Delay Equalizer which is said to simplify the conditioning of group circuits in the 60 Hkz to 108 kHz frequency band for data and facsimile applications is now available. The 7170 Equalizer is designed to equalize a group at levels of −35 dBm to −10 dBm with a maximum envelope delay distortion of 25 microseconds in the 60 to 108 kHz range. It is said to correct distortion caused by transmission lines and equipment so that the resulting envelope delay distortion in a group frequency channel does not vary more than 5 microseconds when the original envelope is distorted up to 25 microseconds. In addition, the output level may be increased up to a maximum of 5 dB.

The equalizer is made up of 13 sections with resonant frequencies in 3 kHz intervals from 64 to 100 kHz. For each equalizer section there is a delay in/out switch, delay adjusting variable resistor, and an amplitude adjusting resistor. The delay in/out switch allows a particular delay section to be switched into the circuit or to be by-passed. The delay adjustment provides continuous delay adjustment from 25 microseconds to less than 7 microseconds. The amplitude adjustment provides for about 5 dB variation per section. Overall adjustments on the front panel provide for controlling the input level to the input amplifier and the output level. *Karkar Electronics, Inc.*

Circle 108 on reader service card

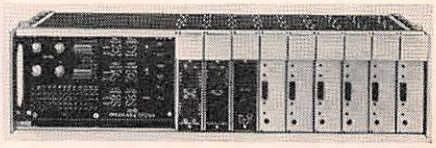


Miniature recorder charts volts and amps

Rustrak series 2120 miniature recorders simultaneously record ac currents from zero to five amps, and offer one, two or three ac voltage recording ranges: 100–140V, 200–280V, and 400–560V. Each channel on the recorder chart paper is one inch wide.

Writing is accomplished by a stylus on rectilinear grid, pressure-sensitive chart paper. Interchangeable gear trains permit a wide variety of chart speeds. Using the appropriate drive motor and gear train permits continuous recording from 1½ hours to more than 1,000 hours on a single roll of chart paper. *Gulton Industries, Inc.*

Circle 109 on reader service card



Six-channel order wire service facility operates in two frequency ranges

The 361B operates in two frequency ranges, with a choice of nine channel frequencies between 12 kHz and 56 kHz or seven channel frequencies between 516 kHz and 544 kHz.

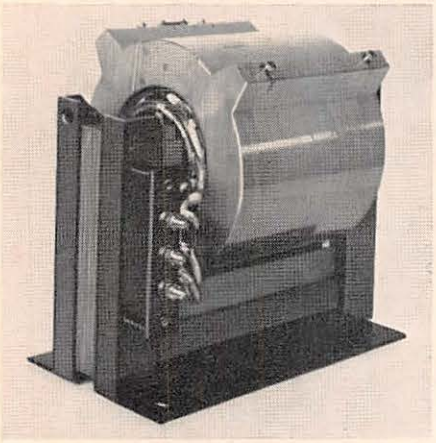
The 361B high-frequency option is suited for order wire applications in Data-Under-Voice microwave radio systems below supergroup 2 of high-capacity multiplex equipment such as GTE Lenkurt 46A3 and 46A6, and Western

Electric equivalent systems. The lower frequency channels may be used on microwave radio systems below supergroup 1.

The standard assembly may be converted from high-frequency to low-frequency use and vice-versa by changing an HF filter plug-in module and by replacing individual channel selection oscillators on each channel unit.

Expansion of channel capacity from one to six channels is on a plug-in modular basis, and without service interruption. The plug-in channel units are equipped for E&M signaling for either point-to-point or party-line operating modes. *GTE Lenkurt Inc.*

Circle 110 on reader service card



Line of high-voltage transformers is offered

A line of Epoxycast high-voltage transformers for powering, among other things, signaling and supervisory equipment for railroads and electric utility networks, is offered by TDC, a division of Frequency Technology, Inc. The transformer line includes units with primary voltage ratings from 2.4kV through 14.4kV, and power ratings of 5 through 50 KVA for single-phase types, extending from 15 through 150 KVA for three-phase versions. Standard output voltages are 120/240V, with primary taps for up to a 7½% voltage variation; other voltages are available on special order. All units are designed to withstand high voltage transients on the input circuit without insulation breakdown and are specified for BIL ratings of 60,000; 75,000; or 95,000 volts. The entire line is built in accordance with ASA Standard C37.20-5.2.1. *TDC Division, Frequency Technology, Inc.*

Circle 111 on reader service card

New line of lead calcium batteries is introduced

Globe-Union has added fifteen new lead calcium stationary batteries to its growing line of Tel/Cell products. The new lines of 2-volt batteries, designated TCC and TCCX Series, offer a range of 685 A.H. to 1680 A.H. at an 8-hour rate. The new TCC Battery Series uses a spark arresting ceramic vent and filling funnel for safer operation and ease of maintenance. Cases and covers are made with high impact material. *Globe-Union Inc.*

Circle 112 on reader service card

BUY

UNITED STATES

SAVINGS BONDS

ELECTRICAL ENGINEER

Engineering consultant in Mass Transit and Railroad Electrification needs electrical engineer with several years experience in Railroad Signaling for design engineering position in Midwest City.
Good opportunity for engineer with supervisory capabilities to advance with Consulting Engineering Firm.
Box 64, RSC, 350 Broadway, New York, New York 10013

A. J. HENDRY, INC.
CONSULTING ENGINEERS

SIGNALS • COMMUNICATIONS • AUTOMATION • ELECTRIFICATION
RAILROADS • RAIL TRANSIT

SUITE 810 OSBORN BUILDING
ST. PAUL, MINNESOTA 55102 (612) 222 2787

Telephone Carrier & Associated Parts

Reconditioned

Western Electric "O", ON & N Carrier, Lenkurt 45, 33A, 81A Carrier Panhandle X, TFM, Lynch, Stromberg-Carlson & Kellogg Line Filters and Associated Parts, Repair and Return Service. All Equipment completely reconditioned and Tested. Complete Solid State Replacements for 407, 408 & 311 Tubes for Lenkurt 45 and W.E.Co. O, ON & N

All work and equipment guaranteed

ALLIED COMMUNICATIONS
EQUIPMENT SUPPLY

Box 395
Council Bluffs, Iowa 51501
Tel. 712 322 2725
Tel. 712 328 3088
4583 Sharon Valley Ct.
Chamblee, Georgia 30341
Tel. 404 451 0065

Circle 8 on Reader Service Card.

Monochrome Monitors

MODTEC

- High Resolution – 800 line for bright, crisp detail.
- Exceptionally High Reliability – 100% solid-state modular construction.
- Ease Of Maintenance – All 5 modules easily replaced for rapid service.
- Reduced Spares – All 5 circuit modules common to CRT sizes from 9 to 23 inches.
- Flexible Installation – Available in chassis, cabinet (with optional hangers) and rack mount models.

Call or Write for Brochure

— MODTEC DIVISION —

BROADCAST ELECTRONICS, INC.
8810 Brookville Road
Silver Spring, Md. 20910
301-588-4983

Circle 10 on Reader Service Card.

SIGNAL SUPERVISOR

VIABLE CLASS I RR NEEDS FIELD SIGNAL SUPERVISOR, SEND RESUME RAILWAY SYSTEM CONTROLS, BOX 65, 350 BROADWAY, NEW YORK, N.Y. 10031.

ADVERTISER'S INDEX

Allied Communications Equipment Supply 29
Broadcast Electronics–Modtec Division 30
EIP 7
Farinon Electric Co. 9
General Railway Signal Co. ....IBC
The Kerite Company 16-17
M.L. Engineering Co., Ltd. 4
NVF Company 25
Safetran Systems Corporation ..IFC
Scanning Systems 28
Servo Corporation of America 20-21
Simmons-Boardman Publishing Corp. 26
Western-Cullen Division .....BC

Off the press!

You can now get your copy of the *Centennial Edition of the Car and Locomotive Cyclopedia* - and have the latest facts and figures of rolling stock at your finger tips.

Here in one volume is massed all the technical, statistical and buying information you need when you purchase, design, build, modernize, repair or maintain equipment. . .

Dictionary of car and locomotive terms • Freight car design fundamentals • Freight train cars • Freight car construction • Railway service cars • Industrial and export cars • Passenger and transit cars • Couplers • Draft gears and cushion underframes • Air brakes • Brake gear • Safety Appliances • Car and locomotive trucks • Axle journals and bearings • Diesel-electric locomotives • Diesel engines • Diesel-electric transmissions • Electrical fundamentals • Car and locomotive maintenance facilities.

Not only does the *Cyclopedia* cover all the basics, it covers what's *new* too. . .

. . .car dynamics—rock and roll problems
. . .automatic devices to cope with hot boxes
. . .automatic Car Identification (ACI)
. . .car redesigns for specific tasks
. . .pollution and other environmental problems
. . .introduction to "people movers"
. . .shop practices, including road rebuilding of cars and power units.

No wonder the latest edition of this every-four-year publishing wonder has 1,020 pages, weighs six pounds, twelve ounces! Order your copy—or copies—of the *Cyclopedia* today.

PRICES: shipping and handling included.
Railroad Men: $23.50 per copy
(ID must be included with order)
Single order: $40.
Bulk order (5 or more) $21 per copy

CAR & LOCOMOTIVE CYCLOPEDIA
350 Broadway
New York, N.Y. 10013

Please send me___ copies at___ apiece.
Total enclosed: $_____.

NAME

COMPANY

ADDRESS

CITY STATE ZIP

You can shop by postcard in

Railway System Controls

HELP YOURSELF . . . to the wide variety of manufacturers' literature shown on the preceding pages. You don't have to write, just circle the numbers on the card below. Then drop the card in the mail (no stamp needed). Railway System Controls will forward your request to each manufacturer and he'll send you complete data free of charge. So . . . get out your pencil and help yourself.

RAILWAY SYSTEM CONTROLS • Reader Service Card

THIS COUPON SERVICEABLE FOR 90 DAYS AFTER DATE OF THIS ISSUE

Circle numbers for more information about products and services. **1 2 3 4 5**
6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51
101 102 103 104 105 106 107 108 109 110 111 112 113 114 115
116 117 118 119 120 121 122 123 124 125 126 127 128 129 130
131 132 133 134 135 136 137 138 139 140 141 142 143 144 145
146 147 148 149 150 151 152 153 154 155 156 157 158 159 160

NAME .....

TITLE .....

RAILROAD .....

ADDRESS .....

CITY ..... STATE ..... ZIP # .....

May 1975

Reader Service Card

Help yourself to information about products, literature and supplies in the signaling, controls and communications areas. Fill out the other side of the card below, tear it out and mail. It's your Railway System Controls shopping guide.

First Class
Permit No. 153
New York, N.Y.

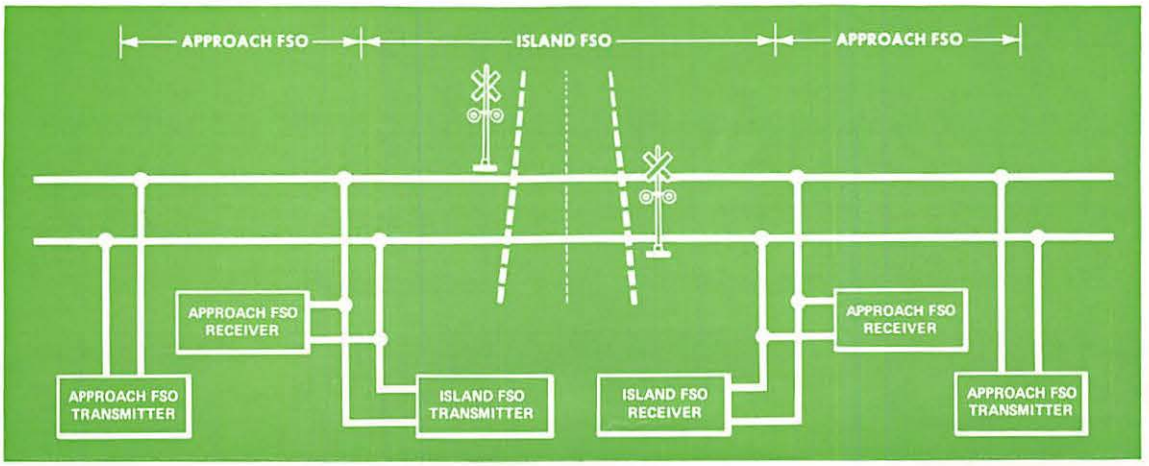
BUSINESS REPLY MAIL
No Postage Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

RAILWAY SYSTEM CONTROLS
350 Broadway
New York, N.Y. 10013

NEW ISLAND FREQUENCY SHIFT OVERLAY TRACK CIRCUITS

FOR HIGHWAY CROSSING PROTECTION



Precise Tuning - narrow band widths and high operating frequency channels provide maximum shunting sensitivity and precise tuning with minimum interference.

Choice of Three Frequencies - 13.8 KHz (channel 25), 17.0 KHz (channel 26), and 20.9 KHz (channel 27) - mutually compatible with each other, with the fifteen approach FSO frequencies, and the three series FSO frequencies.

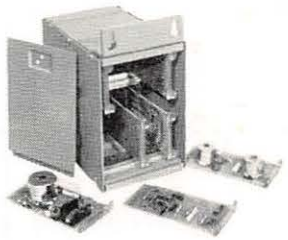
Compact - the transmitter and receiver each occupy the space of a GRS Type B, Size 2 relay - 5 inches wide, 7 inches high, and 9 inches deep. They can be shelf, wall, or rack mounted.

Easy to Maintain - solid-state components are mounted on plug-in circuit boards for quick and easy maintenance.

Versatile - frequency determining elements are on three printed circuit boards. Simply replace these boards to change the operating channel frequency.

Conveniently located terminals for track, power, relay, and ground connections.

Selection of Transmitter Output - 600, 400, or 200 milliwatts for track circuits up to 300 feet.



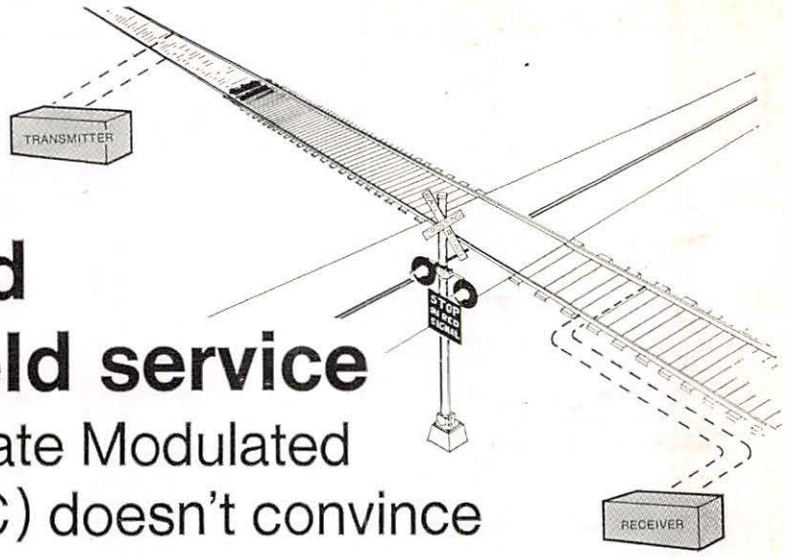
Plug-in units for quick and easy maintenance.

GRS

GENERAL RAILWAY SIGNAL
A UNIT OF GENERAL SIGNAL
ROCHESTER NEW YORK 14602

3613

Circle 2 on Reader Service Card.

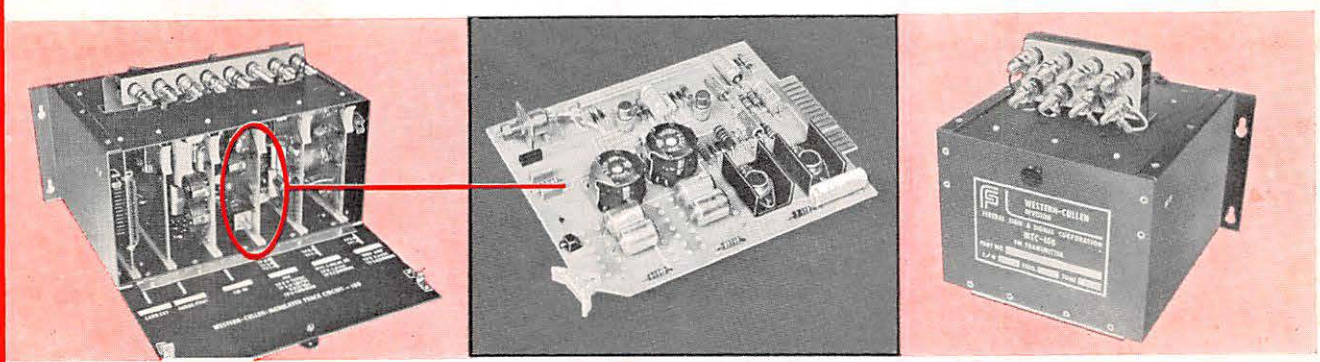


If the higher reliability and simplified field service

of the **WC** Solid State Modulated Track Circuit (MTC) doesn't convince you *it's your best buy, its superior performance will!*

These MTC-100 Features Assure HIGH RELIABILITY, SIMPLIFIED SERVICE

- Gold plated, double sided printed circuit card connectors with plated-thru holes
- All modules have polarized connectors
- LED (light emitting diodes) indicators
- All modules equipped with card ejectors
- Plug in transistors and integrated circuits
- Fail safe design



RECEIVER: 40-2000 SERIES
One card extender furnished with each receiver for servicing transmitter and receiver modules.

HIGHEST QUALITY CIRCUIT BOARDS AND COMPONENTS ASSURE MAXIMUM RELIABILITY.

TRANSMITTER: 40-1000 SERIES

All modules are equipped with LED indicators to show that the modules are functioning properly. The LED's can be used for level adjustments during installation without the need for special test equipment.

All modules have polarized connectors so that it is impossible to insert a module in a wrong position.

The WC MTC-100 transmitter and receiver operates over a temperature range from −40°F to +160°F.

Anodized housings provide maximum protection to assure long life.

Warranty on all defective parts and workmanship.*

Write or call Bill Schneider 312 - 254-9600 for MTC-100 Bulletin and prices.

*2 year warranty from date of sale, 1 year warranty from date of installation.

SC 731

WESTERN-CULLEN DIVISION

FEDERAL SIGN & SIGNAL CORPORATION

"THE FUTURISTS"

2700 West 36th Place • Chicago, Illinois 60632

Circle 3 on Reader Service Card.